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EDHEAD

Sad days...

I feel kinda bad saying this, and I almost fear that as I type, some rabid reader is going to leap out from behind a bush (or printer, more accurately), and bash me over the head for what I am about to say.

You see... I'm really glad that I decided to play Skyrim on Xbox, rather than on PC.

We gave the game a Hot Award, and we stand by that. But it may well have been a very different case if we'd had the

opportunity to review the game on PC, as we originally wanted.

I've heard very few positives about the game on my preferred platform, and Ashton Mills - our resident modding expert - is utterly aghast at the ongoing patching of the game and how Bethesda's handling it. Each patch sneaks in new DRM, or breaks the game further, without actually addressing the incredible flaws that are making the game unplayable for a large amount of the playerbase.

On Xbox... I'm having none of those issues. Man... it hurts just saying that.

Of course, it doesn't hurt that as summer approaches, that the TV is in the most air-conditioned part of the house. Handy, really, as I suspect I'll be spending quite a lot of time in the icy environs of Skyrim.

Perhaps I should turn it way down, for some serious cold weather immersion.

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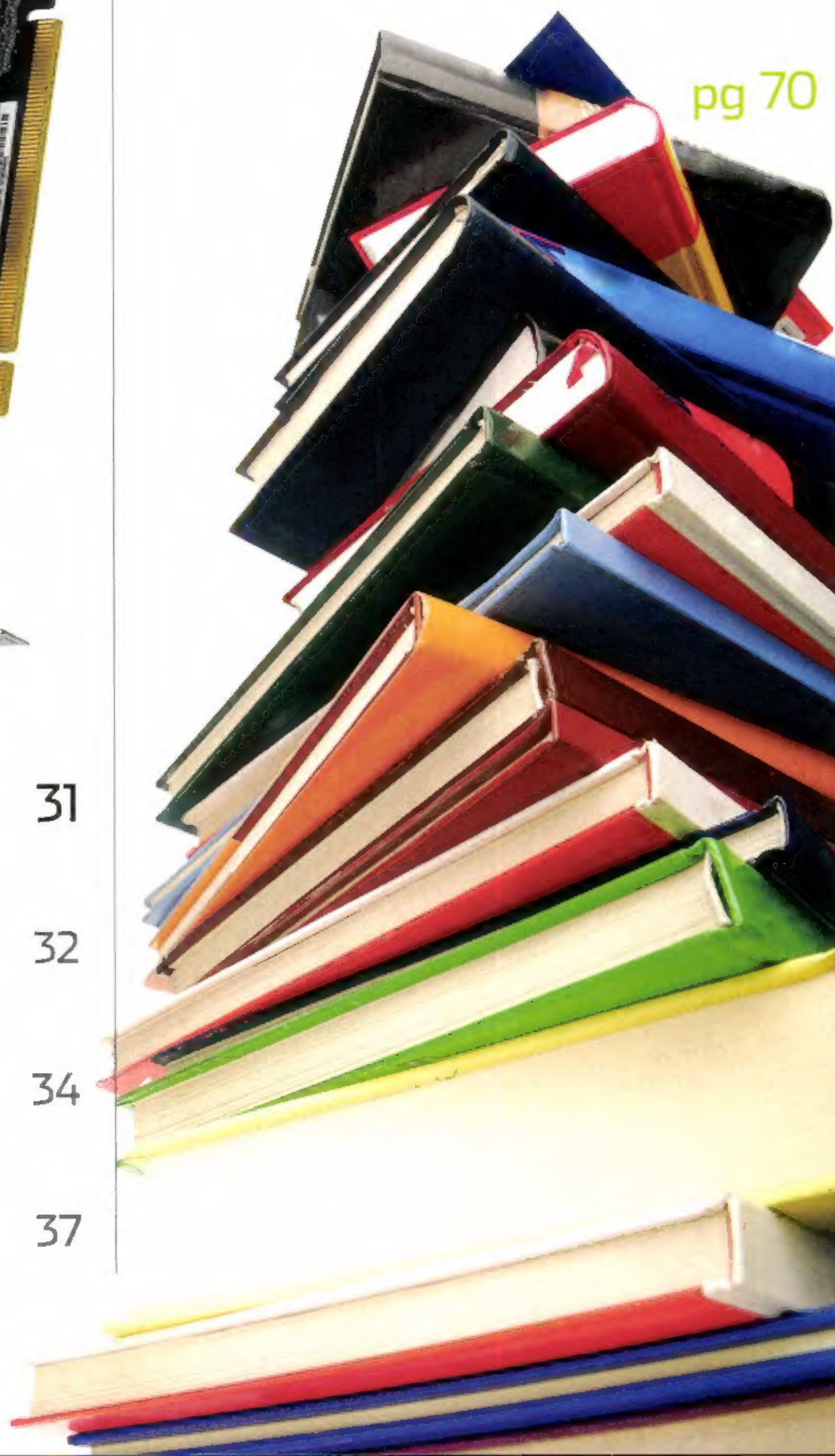
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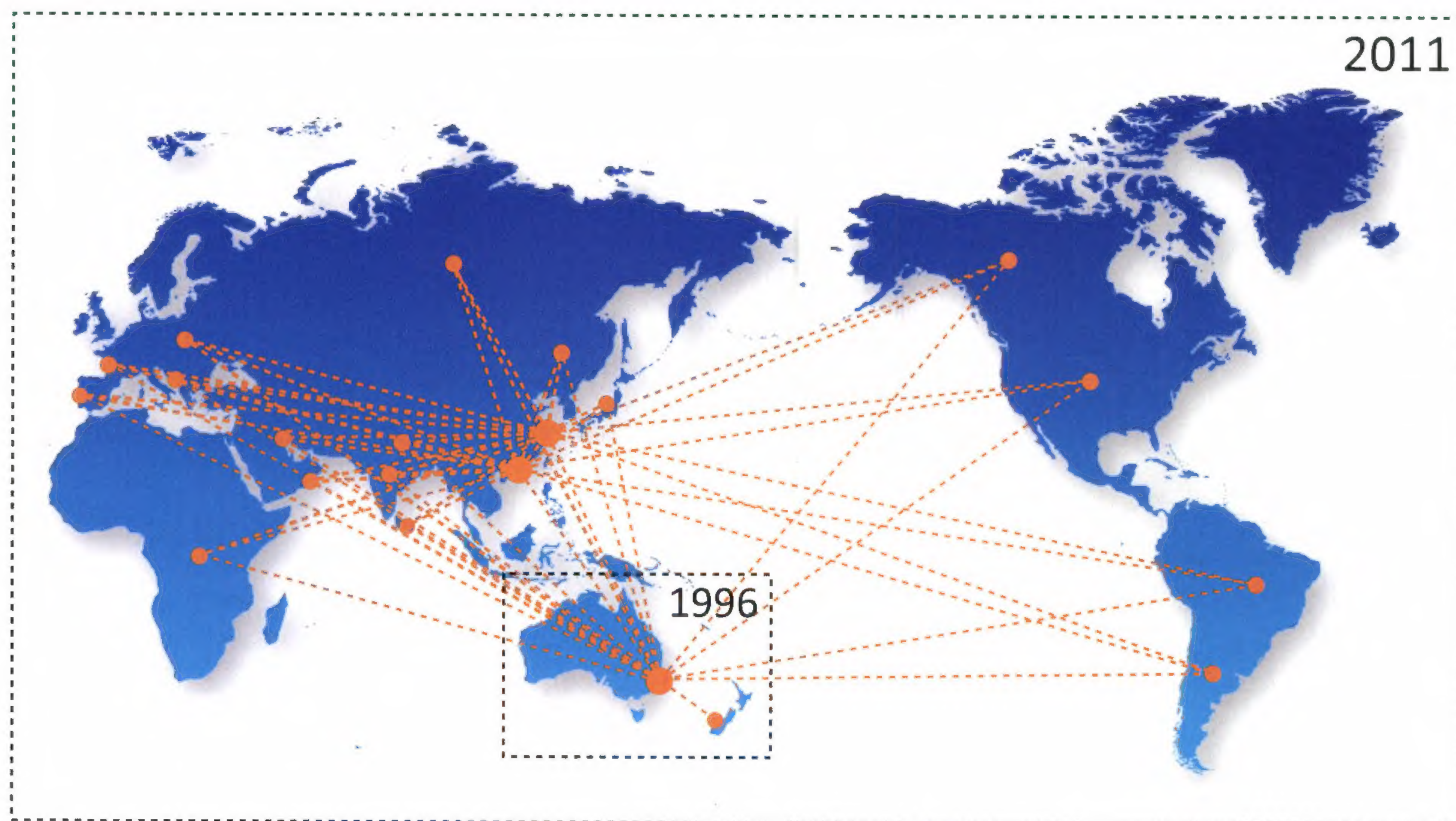
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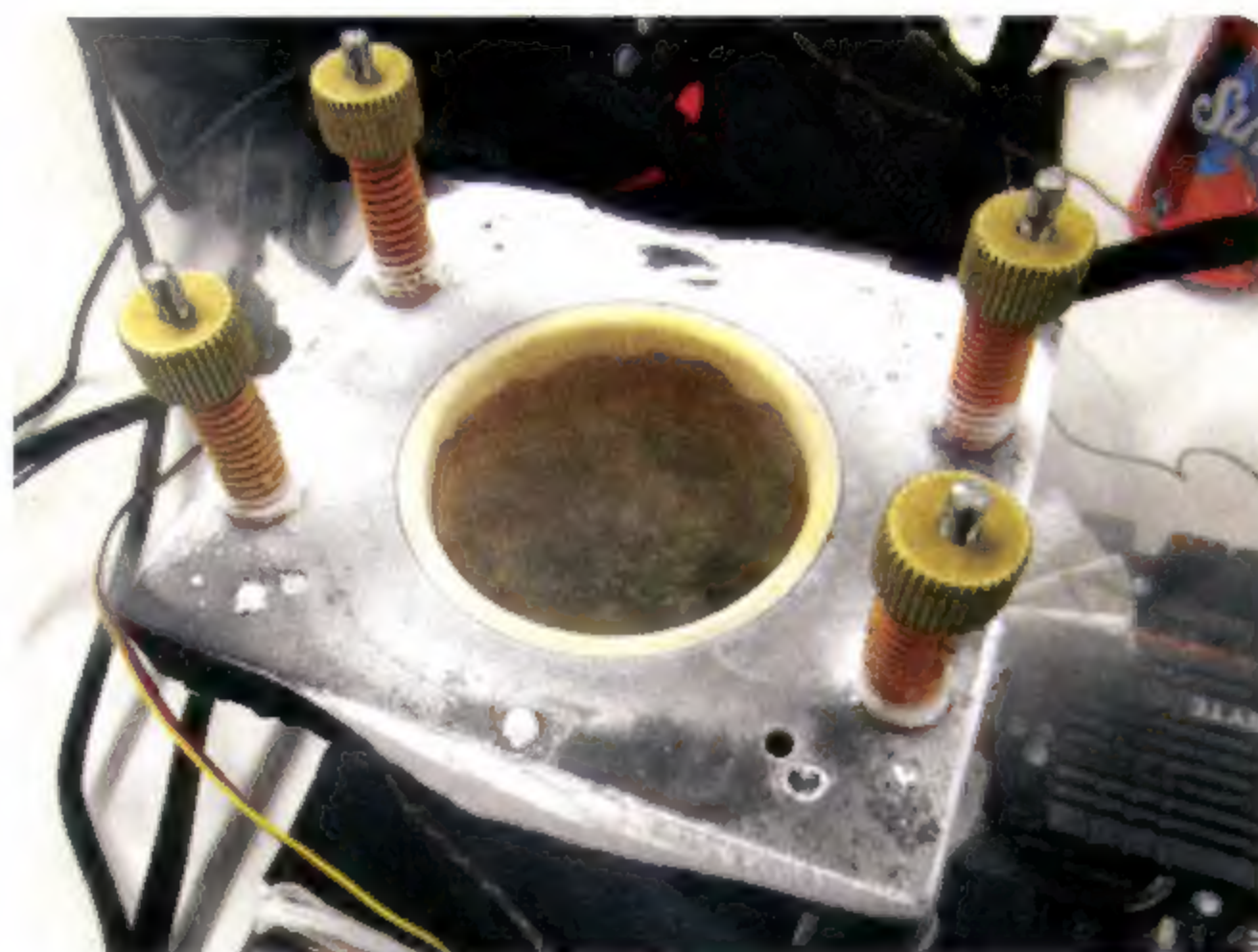
GIGABYTE's Brisbane Extreme Overclocking Event a massive success

Last month we went to Brisbane to watch TeamAU and a bunch of Atomicans push AMD's Bulldozer chips to their limits.

Last month a bunch of lucky Brisbane-based Atomicans and Umart customers had a chance to learn how to use liquid nitrogen to overclock AMD's new FX-8150 CPUs. The event was run by four members of TeamAU, with some of the best overclockers from Australia and New Zealand showing how to get the most out of an FX-8150 CPU running at -170 degrees.

What was most impressive was the level of skill on show from the participants. Two of the teams managed CPU speeds over 7GHz, and the end results of the 3DMark05 competition run on the day were incredibly close (3DMark05 was chosen due to it being very CPU dependant). We even got to see one CPU die during the event, pushed beyond its limits.

Big thanks to TeamAU, GIGABYTE, AMD, Corsair and Umart for getting the event off the ground. It was a fantastic turnout and the



general level of overclocking skill on show was impressive indeed.

Check out our gallery online (<http://www.atomicmpc.com.au/?281560>) for more info on the teams, setups and overall results from the day's sub-zero shenanigans.

MechWarrior Online to use CryEngine3 – woot

Good news for Mech pilots everywhere - MechWarrior Online is going to look very pretty, feature some serious physics, and generally be a mess of fun with some help from Crytek.



What's more fun than crashing around a city in an 80-tonne mech, destroying the enemy and generally being like some heavily armed and armoured god of future warfare?

Doing it in a game with a seriously high-powered engine - like, say, in MechWarrior Online, which has just announced that it'll be using Crytek's CryEngine3 to pump out those juicy frames.

It's an interesting choice. Our one big issue with Crysis 2 was that the levels were obviously optimised for a more linear,

console-friendly form of gameplay, so it'll be interesting to see what this PC-only title can do with the game's engine. Certainly, it'll be great to see some serious physics and destruction come into play, which is what the developer, Piranha Games, is promising.

And don't forget - you can sign up and reserve your pilot's name now, and get in line for the upcoming beta at the official site (<http://mwomercs.com>).

Between this and Hawken, the future is looking good for mecha



Another month, another great selection of thought provoking posts on gaming, technology and pretty much everything else on the Atomic forums. And now we get to celebrate the best of the best with a shiny prize from Razer!

So who's the big brain who's entertained/provoked us this month?

It's **nich...**, whose thread on gender roles and marketing kicked off some great discussion!

<http://forums.atomicmpc.com.au/index.php?showtopic=46557>

Well done, **Nich...**, and everyone who made that such an interesting thread. Of course, he's not alone...

Lunchbox 1988 provides some networking help.

<http://forums.atomicmpc.com.au/index.php?showtopic=46167&st=0&p=927173&#entry927173>

And **komuso** shares some thoughts on anger management.

<http://forums.atomicmpc.com.au/index.php?showtopic=46497&st=40&p=933456&#entry933456>

Nice work everyone!



MODIFICATION

With Ashton "Two mods are better than one" Mills.

ACM Mod

Game **Sword of the Stars**

URL www.kerberos-productions.com/forums/viewtopic.php?f=16&t=6835

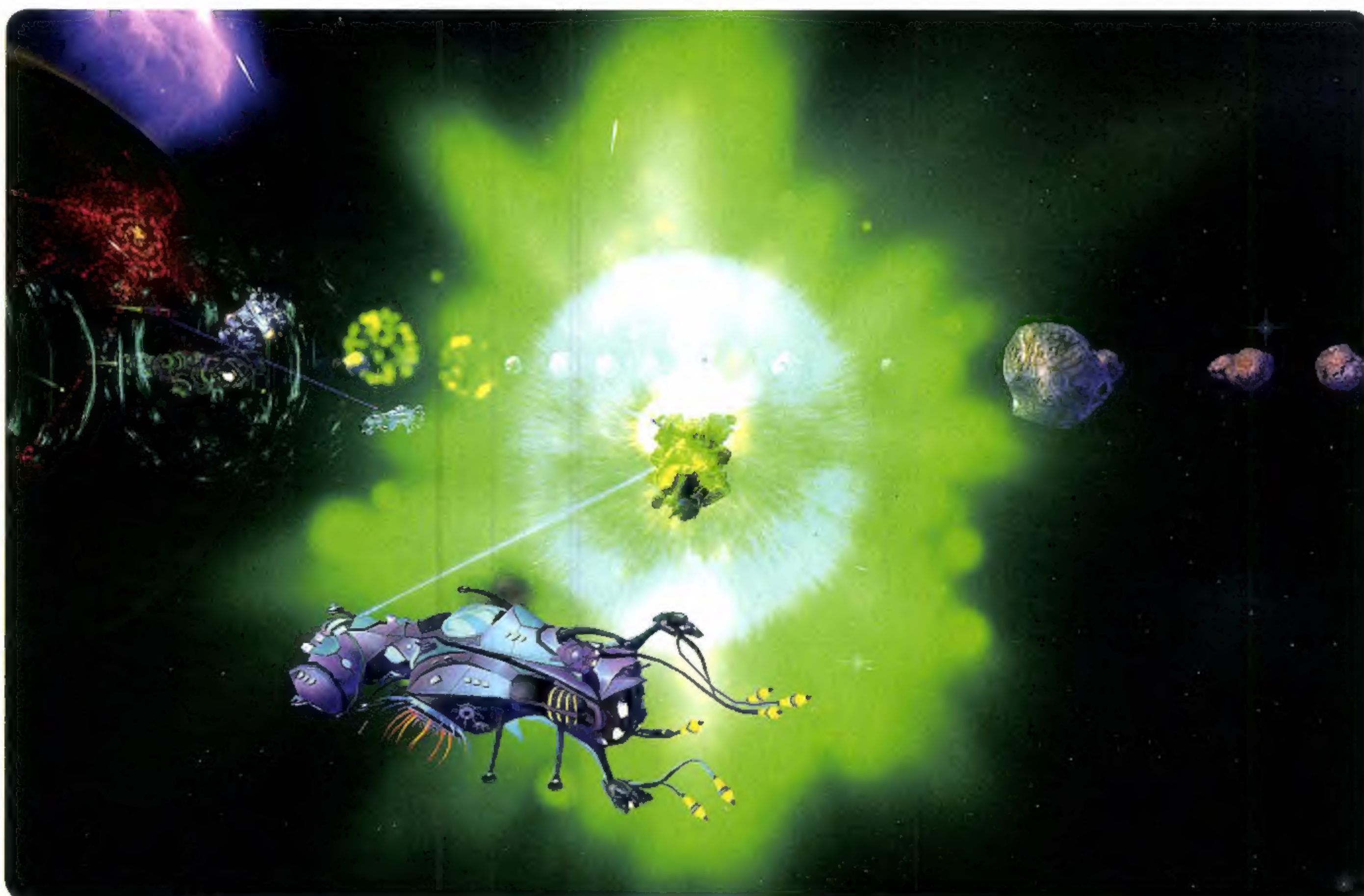
With the train wreck that was the Sword of the Stars II launch (if you haven't been following the scene, Kerberos released their much-anticipated sequel in what was basically an alpha state, incomplete and unplayable), many SOTS fans turned back to the original in order to satiate their need for universal conquest.

And while the original SOTS is a gem in its own right, as usual, mods can help tweak and poke the voluminous mass of strategic joy into an even *more* voluminous mass of strategic joy. Which is to say, make it more engaging and fun.


One of the most polished and popular mods to do this is the ACM mod by Okim. ACM revamps some of the core components, introducing a 19-branched tech tree, a whole bunch of new weapons including triple-barrelled variants of many weapons, reworked planetary assault with weapons rebalanced to encourage shuttles and bombs, completely new models and textures for human ships, new ship segments for ship designs, new graphics and particle effects, and increased research times to better appreciate the tech levels and make use of them as you play.

Once you start playing with ACM you find the original SOTS, while great, a tad lacking by comparison. Definitely recommended for multiplayer games, just be sure that everyone is using the same version of the mod.

Despite SOTS being a relatively old game, ACM has seen continued development and its



most recent update was only a few months back. SOTS2, in its broken state, may have better graphics but SOTS is where the gameplay is still at, and ACM takes it to new levels.

Now if you excuse me I have some Hivers (and their damn gates!) to exterminate... 



Skyrim essential mods

Game Skyrim

URL www.skyrimnexus.com/downloads/file.php?id=1013 and 88

Skyrim is beautiful, fun, and downright addictive. But like all of Bethesda's games, it's buggy to all buggery. Naturally the mod community jumped onto it quick-smart, and within a week after release there were already a few *hundred* mods, even sans the Construction Kit. To be fair, some of the Oblivion and Fallout 3 user-made tools have been roughly adapted, and some customisation is possible, but we still need the Kit for major changes.

If you're a regular reader of these pages but don't usually try mods, and you've got Skyrim, now is definitely the time to get into using mods. Primarily because the following mods improve stability, performance, and the interface, with minimal effort:

LAA fix – the Large Address Aware fix, which is little more than setting the LAA flag on the .exe so the game can use more than 2GB of memory, has solved crash and performance problems for the majority of the user base – until Bethesda released its ninja patch (see this month's Technica Obscura). Right now there isn't an official fix, but an updated memory-resident tool can bypass the Steam checksum wrapper and restore LAA support to your Skyrim. Everyone

should be using this.

Hard coded key tweaks – There are so many great things about Skyrim, but the interface is not one of them. Until the 1.1 patch the menus couldn't even be used via mouse properly on the PC. The interface still sucks, but at least some enterprising modders are trying to help. The hard coded key tweaks mod allows you to use mouse buttons to close elements (books, map, dialogs etc), zoom items in the inventory with the mouse, bind a mouse button to the Activate function (open doors, pick up objects et al), equip weapons to keyboard attack keys, and use mouse buttons to browse menus.

Obviously Skyrim has a giant amount of modding potential, and there will be plenty of other mods to improve your Skyrim experience, so look out next issue for the comprehensive *Atomic tweaking and mods guide for Skyrim* that is bigger than a mammoth's... mammothy bits. 





PATCH notes



Star Wars: Battlefront 2 Unofficial
Patch v1.3

F1 2011
Patch v1.2

StarCraft 2: Wings of Liberty
Patch v1.4.2

The Witcher 2
Patch v2.1

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Panasonic PT-AR100E home projector

Price: \$3079 Website: www.panasonic.com.au

Once upon a time having a large, blank, white wall in your house was a sign from the Gods that you need many more Ghost in the Shell posters (speaking from personal experience here). These days, though, it might also be a sign from the Gods that you've got a perfect opportunity to show off your AV dedication and purchase a neat home entertainment projector.

If that's your home situation, then you might be tempted by Panasonic's latest offering. The PT-AR100E home entertainment projector offers full HD, 1920x1080 images, via a 280-watt lamp that is a huge 2800 lumens in terms of brightness. It can adjust picture quality to match room conditions, and can be used pretty much straight out of the box.

Sadly, it cannot make popcorn for your home cinema setup, nor will it do anything about the annoying friend we all have who asks dumb, obvious questions about whatever they're watching, and then asks what he missed while everyone was talking (Roger, we're looking right at you).



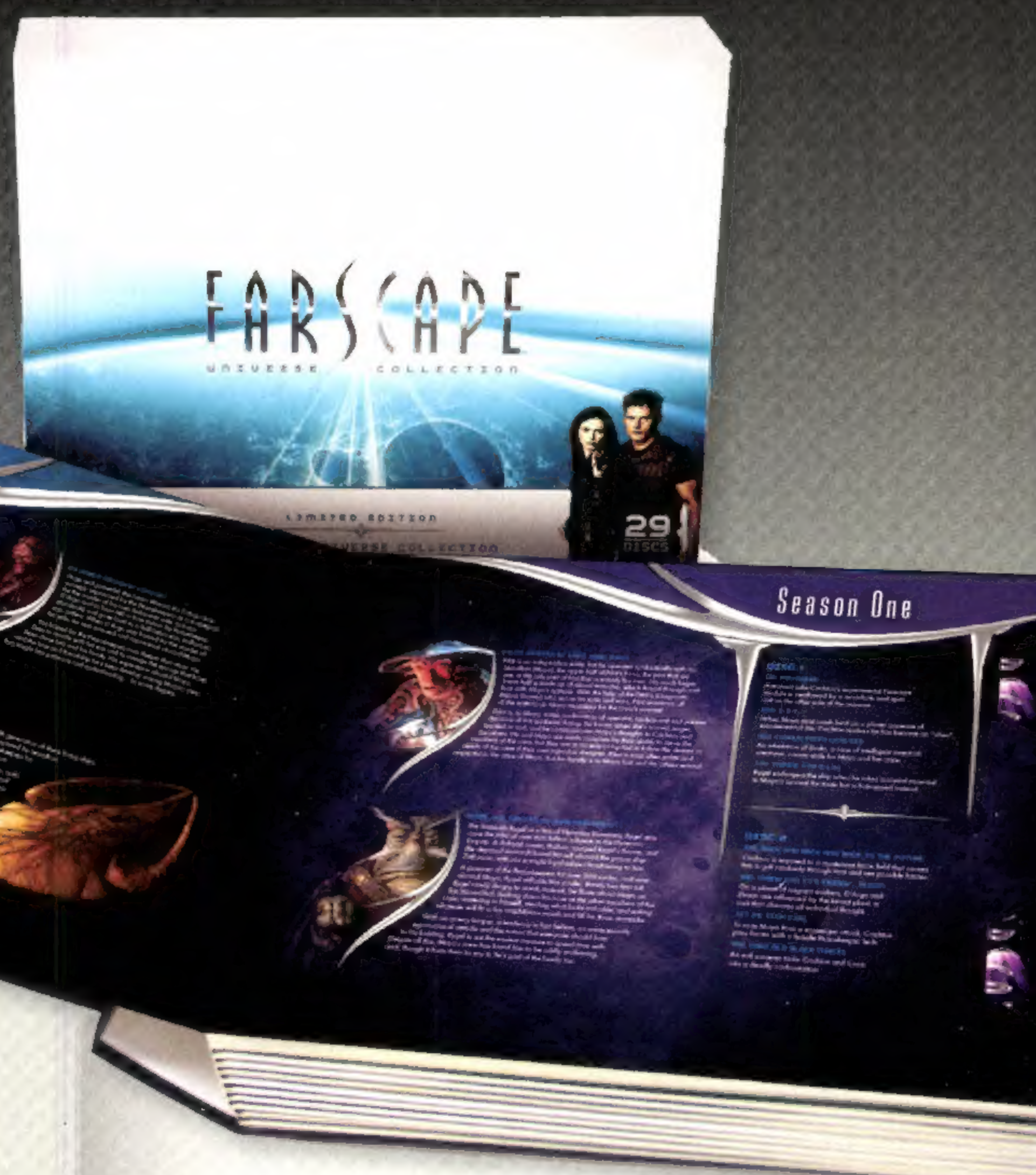
TEAC SR-80iDABp dock and digital radio

Price: \$399 Website: www.teac.com.au

An Aurb sounds like it should be some kind of strange alien lifeform in a space opera – or Futurama. What it actually is, though, is a combination speaker dock for your handy iDevice, with a built-in DAB+ radio.

If course, if you're not iIntegrated, you'll likely ignore this right away, but for those iEnabled and wanting to keep ahead of the digital broadcasting curve, it's a perfect device. It offers simultaneous playback and charging of your iPod or iPhone, and throws out hi-fidelity radio. There's also a USB jack for MP3 and WMA playback, an auxiliary jack and standard AM/FM tuner – it's a complete listening device!

And hell, with a video output included, you can even plug it into a TV for some moving image time.



Farscape Complete Collection

Price: 179.95

Website: www.beyondhomeentertainment.com.au

If you've not seen Farscape, you really are missing out.

This cult-hit SF TV show introduced viewers to the adventures (often leatherclad) of John Crichton, a lost astronaut thrown to the other side of the galaxy by an accident, and his travails amongst the crew of the living starship, Moya. It really is some of the best SF ever made on television, though we may be a little biased.

And now, you can watch it all (or re-watch, if you're like us) thanks to this cool box set that includes all four seasons, plus the full length film that wrapped it all up. Combined with a character guide, technical info on ships and weapons in the series, and all in a neat package, it's essential for all fans.

We will note that the seasons are available individually in retail stores for \$20-odd each if this collector's pack is too much of a stretch – but still definitely worth picking up!



Kaiser Baas Digital Microscope

Price: \$79.95 Website: www.kaiserbaas.com

The blurb for this scientific mini-odddity claims that it's perfect for "students, insect buffs, collectors or those wishing to play detective and study what the naked eye cannot see". Well, fair enough, but really, let's get down to brass tacks.

You're just going to use this to look at gross stuff and post pics of it to Facebook.

But hey, we're down with that, and it's kind of like science. Regardless, this microscope is pretty neat; it features adjustable LEDs to illuminate whatever disgusting bodily fluid you want to look at up close, snapshot and video functions so that you can share your crude excretions, and a two megapixel CMOS on a moveable arm.

The Digital Microscope comes with Mac and Windows drivers, and "software which allows for accurate measurement of anything you may be studying". That sounds like a challenge...



Kaiser Bass Personal Media Player

Price: \$169.95 Website: www.kaiserbass.com

Personally, we think pretty much any tablet has really superseded this device, but if you only want to watch stuff when you're on the go, it's hard to go past this Media Player from Kaiser Baas.

It's got 4GB of onboard storage, and supports a wide range of formats, including HD files like MKV and H.264. It can also go the whole electronic picture frame route, by showing off a mess of image formats in a slideshow. You can even boost the storage with an SD card, or use the USB port for external storage options. It can even double as an eBook reader. You know what – this does actually sound pretty neat!

BATTLEFIELD 3



All Platforms
OFLC Video Game Rating
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GAINWARD



Photonic emanations

Jake Carroll gives us a sense of how we record digital images.

If there were ever a technology that had become almost ubiquitous in everything we own, it would be the image sensor. These unassuming bits of silicon are responsible for all those horribly cute photos of cats on the internet, that job you didn't get because your prospective employers saw you acting like a complete tool on Facebook, and your resulting oh-so-sensible decision to change your privacy settings. This month, X-Ray explores image sensors and how they are evolving. We'll look at the design and technology behind the image sensor and peer into the megapixel war a little, to reveal some truth behind the marketing. Let's get started.

I spy with my little eye...

They are in the camera that you take on holiday. They are in your mobile phone. They are in your laptop, to sense ambient light. They are in your brand-new flat-panel TV for the same

reason. Image sensors have complex industrial applications in robotics, automation on product lines, and machine learning assisted-vision. They are broaching new frontiers in human-computer integration in the form of cybernetic implants for people with poor or no vision at all. There are even mouse products and other computer peripherals that use image sensors to track movement and gestures instead of LEDs and LASERS. In other words: they're everywhere.

Making sense of sensors

Put simply, an image sensor is a device whose function is to allow the capture of photons, which interact with the sensor itself and causes the movement of electrical charge inside the device, which can then be manipulated in some way. This manipulation is most commonly a conversion to a digital value. These charges are stored in compartments on the sensor,

known as **bins** or **wells**. The charges in the compartments are then determined, or read from, and are sent to a system processor to turn that data into what we humans would interpret as an image. The information the sensor has captured went from being pure sub-atomic particles (photons), to electrons, then onwards to actual pixel data.

At this point, our many astute readers will suggest we are forgetting something about the latest generation of digital cameras and imaging devices; that two prevailing technologies exist in the image sensor market. These are:

1. CCD (charge-coupled device)
2. CMOS (complementary metal-oxide semiconductor)

Both these technologies share the property of taking and storing information from a

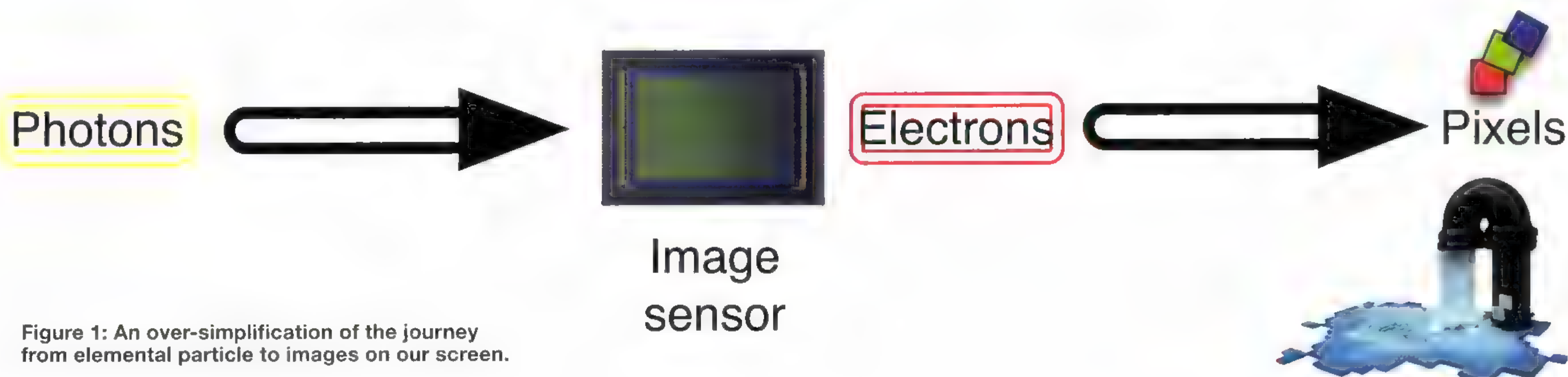
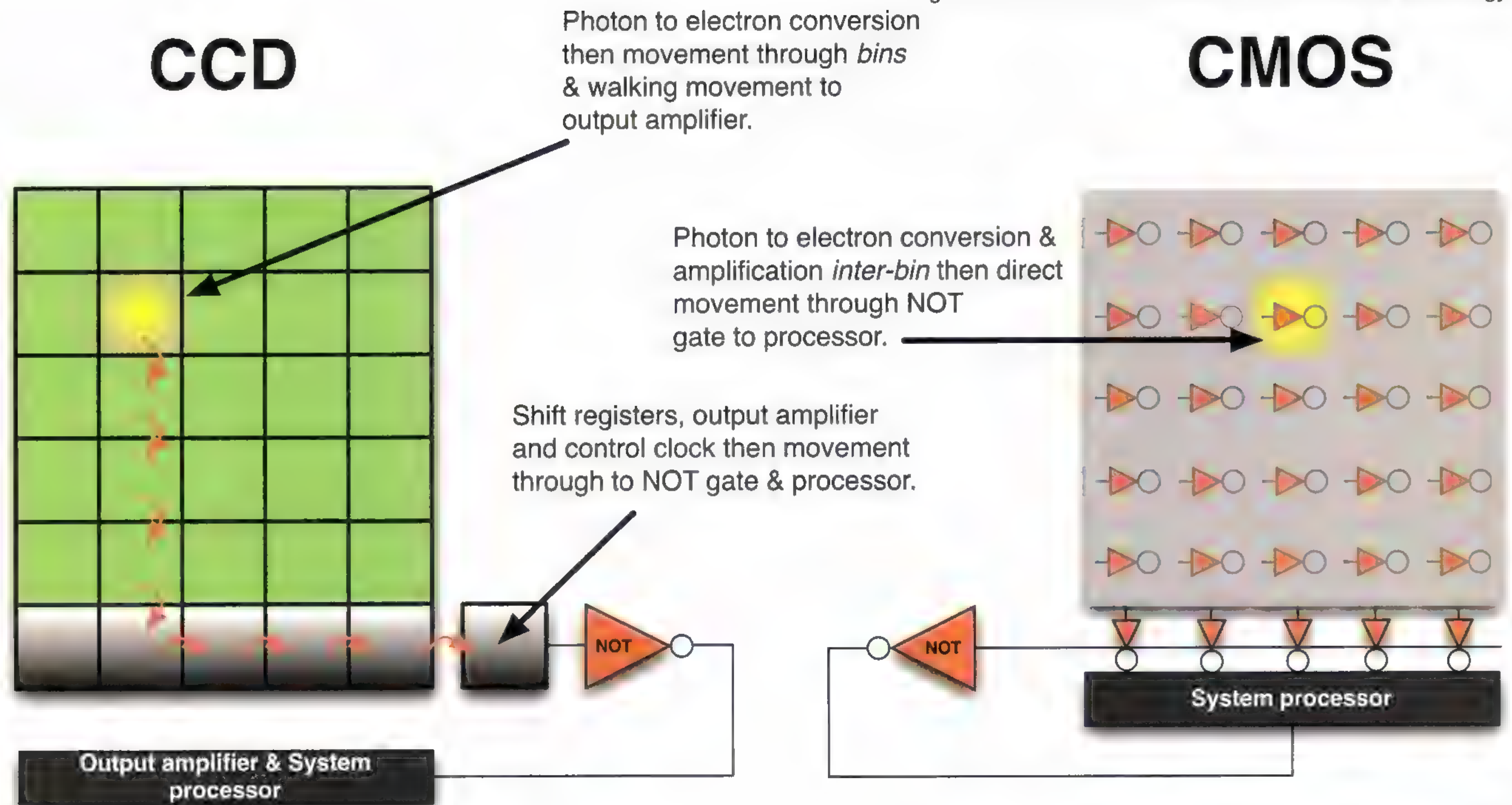


Figure 2: The difference between CCD and CMOS technology.



charge captured through a photodiode. Both technologies rely on the conversion of photons to electrical charge. Even though they achieve the same outcomes, the differences between a CMOS and a CCD are quite significant, and are unbeknownst to many.

Humble beginnings

William Boyle and George E. Smith invented the CCD in 1969. Like so many other things we discuss here in X-Ray, it was born inside AT & T Bell Labs. Originally they called the technology a Charge Bubble Device. The first paper discussing the topic pointed out many uses not related to imaging, including memory systems to store data, and delay lines. The very first experimental device demonstrating how a CCD could work was a row of closely spaced metal squares on an oxidised silicon surface, electrically accessed by very fine wire bonds. By around 1971, Bell Labs were capturing images in monochrome in an 8-bit register.

From there on, giants such as Texas Instruments and Sony's Kazuo Iwama went on to successfully mass-produce CCDs. Iwama was to die before this market came to fruition. A CCD was put on his gravestone as a memorial and testament to his work in the creation of the first consumer grade CCD in August 1982. In contrast, CMOS was a low-key affair, patented in 1967 by Frank Wanlass. Frank was an engineer working for Fairchild Semiconductor at the time. The CMOS, however, was not born to capture images as CCD was. It was initially dragged into this world as a low standby power complementary field-effect circuit. Think of that as the ROM chips that store your BIOS configuration on your motherboard.

CMOS vs. CCD

CCD devices move photon-generated charges from one pixel compartment to another pixel compartment along a register chain, which is then converted to a usable voltage at an output node. It is then passed along to an image-processing device to produce a visible image. CMOS imaging devices convert photons to voltages inside each bin, passing back through a NOT gate at each point in the process. The NOT gate inverts the voltage passed through it, amplifying the low-voltage charge into a high-voltage one. The CMOS is in a way carrying out all the steps of a CCD 'on chip'.

CCDs were considered superior for a long time in terms of noise ratio and image quality. As a result, pre-2001 digital cameras more prominently featured CCDs than CMOS sensors.

There were three main arguments around a decade ago for the redevelopment of CMOS as an image technology to compete with CCDs:

1. Lithography and micro-fabrication techniques were advanced enough to produce the same level of low-noise image quality as a CCD.
2. CMOS had lower power consumption than CCD.
3. CMOS used a prolific technology that had matured in the manufacturing of CPUs, motherboards and other ultra high-speed switching components, so was easy to scale up in production for little investment.



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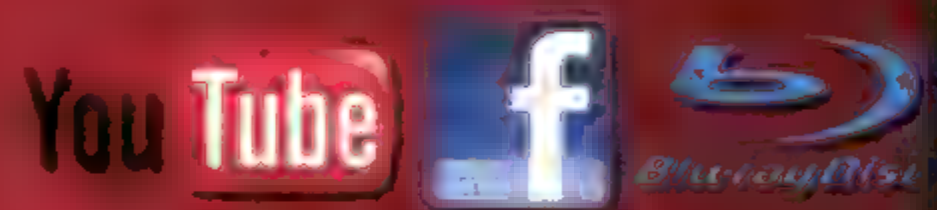


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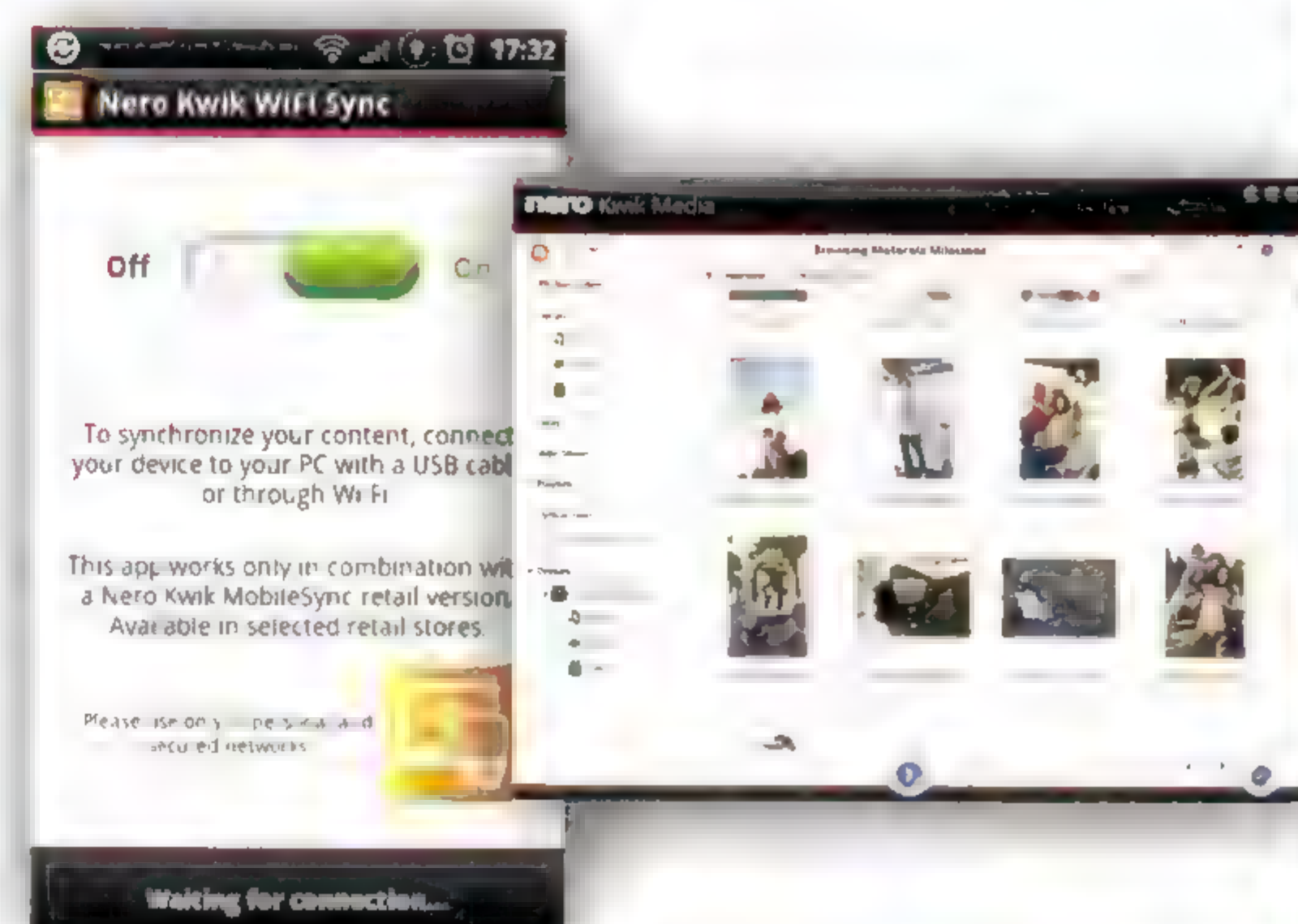
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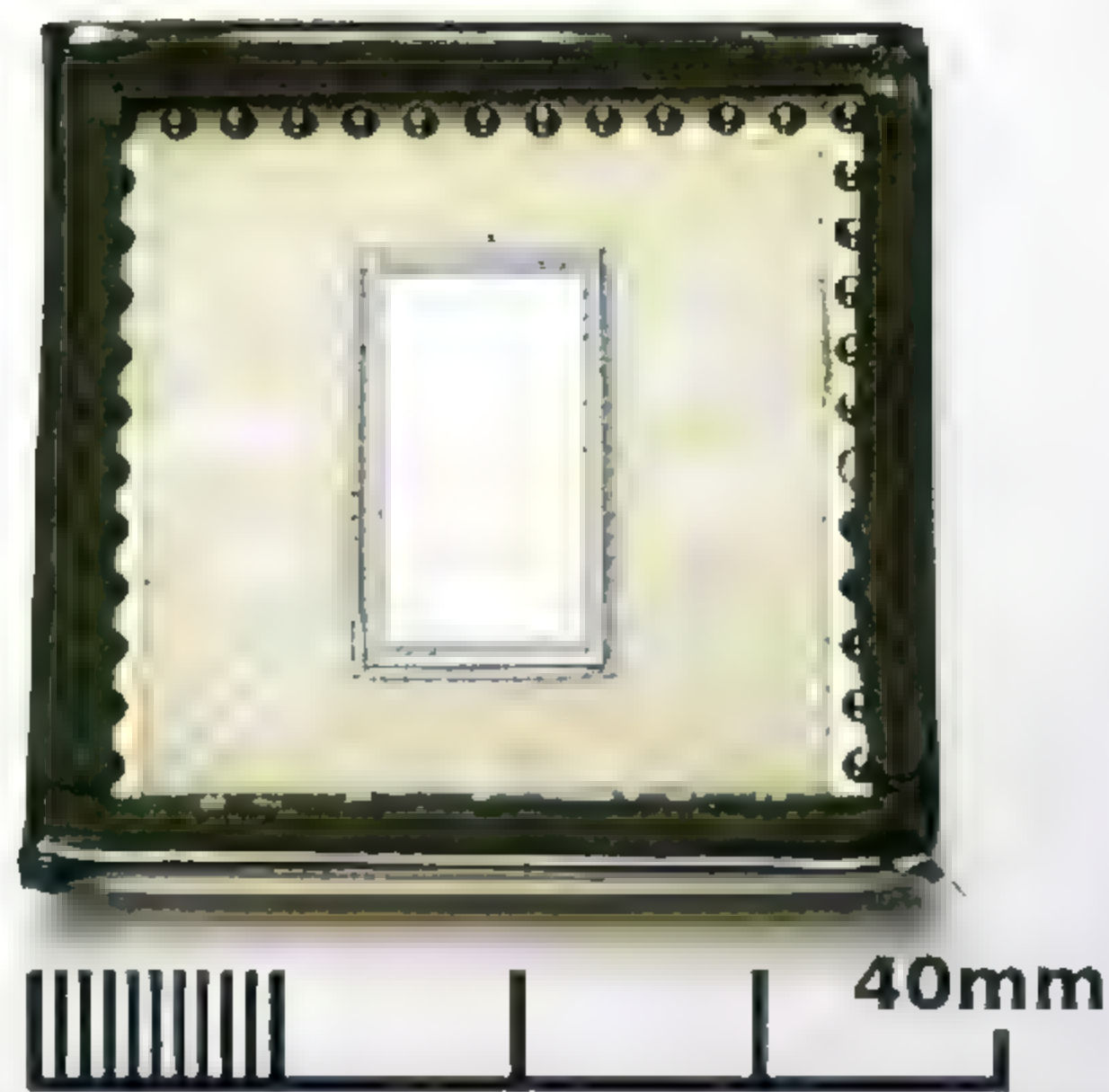


Figure 3: Frame-Transfer CCD.

There is one final argument for the renaissance of CMOS. The switching and silicon area of a CMOS chip allows it to act like a system on a chip (SoC), similar to the devices you'd find in Android or Apple smartphones. Think of a SoC as being a whole device on a single piece of silicon, with all the functionality you might otherwise acquire from multiple separate chips. This might include networking, sound, video decoding, hardware and mathematical processing, sensing, and imaging. Examples are the Broadcom SoC for networking, NVIDIA's Kal-El for tablet computing, and Canon's DIGIC V+ for imaging.

Present-day sensors

Consumer imaging technology is hovering around 16 megapixels (MP); at the 'prosumer' and professional level it currently sits around 18MP; and in extremely high-end industrial markets, around 45MP.

The current trend in the consumer and professional markets is towards CMOS sensors rather than CCD image capture devices. Currently, it makes more sense to concentrate on CMOS, as it offers a lower latency for the path of photon to image (given that the photon path is converted from charge to image data on-chip as we show in Figure 2), and is cheaper

to manufacture.

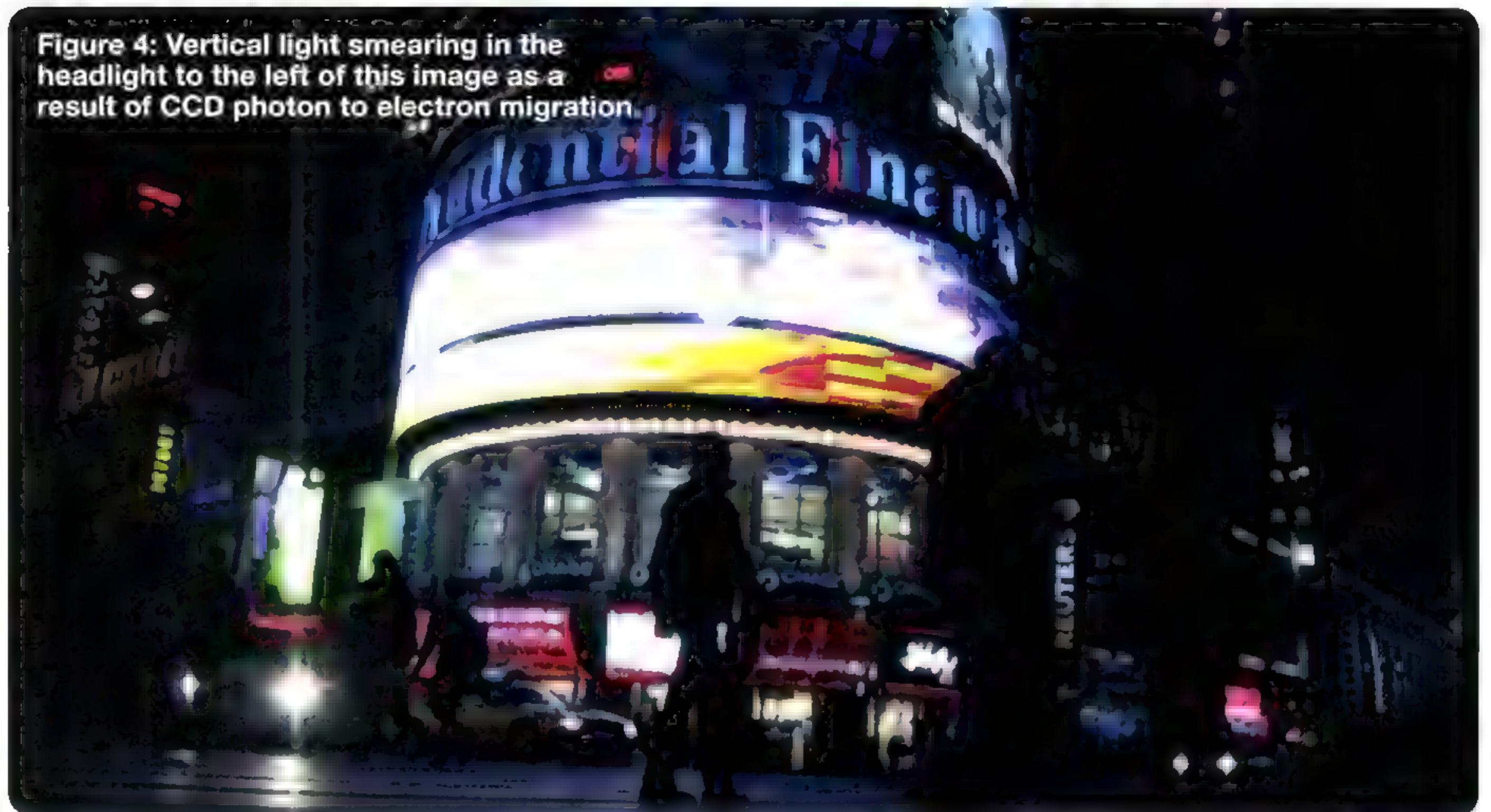
CCDs have a niche market in highly specialised scientific imaging systems where ultra-low noise tolerances are required. This has the drawback of requiring extreme cooling. Companies such as Texas Instruments, Carl-Zeiss, and Princeton Instruments, strive for ultra-accurate liquid cooled CCDs where accuracy of image without noise is critical, given the microscopic or extremely high-resolution nature of the work at hand.

Sensor show-stoppers

Much like Moore's law, there are limits to what can be achieved physically with lithography and silicon oxide atomic lattice stability before sensors begin to heat up, and therefore becoming very noisy. The overall goal is, and always has been, quality in a small space. Camera technology from high-end industrial manufacturing groups such as PhaseOne, Hasselblad, Leica and Zeiss are capable of 80+ megapixels in sensors made up of 9372 x 9372 pixels. Given current pixel pitch and density constraints, the bodies of these devices are too large to be practical or portable to hold in one hand.

Certain technologies aim to change this

Figure 4: Vertical light smearing in the headlight to the left of this image as a result of CCD photon to electron migration.



size-versus-quality scenario through use of extra on-chip assistance. The EMCCD (Electron-Multiplying CCD) is a standard charge-coupled device where an additional gain register is placed between the shift register and the output amplifier. This gain register is split up into many stages. At every stage, the electrons in these gain registers are multiplied by a concept known as impact ionisation. The gain can be so high that a single electron can result in thousands of electrons. Reading a signal output from a normal CCD will generate a barely-reliable noisy image. In an EMCCD, the signal is amplified into thousands of electrons, and as a result, the devices have a low-to-negligible readout noise.

Further still into the development of CCDs are Frame-Transfer CCDs (FTCCD).

These highly specialised devices are often used in the life sciences, astronomy and high-end video production, and are used to avoid noise-related problems that exist in current CCDs. The issue with current CCDs for highly-precise and light-intensive applications is their two-stage process. The first stage involves exposure. The CCD passively collects photons, storing them as electrons in the **bins** discussed earlier. The next stage, after the exposure time has lapsed, is the read-out and storage phase. The information from the bins is read out one cell at a time, and passed along the chain to the image processor. Unfortunately, as these cells accessed 'down' the CCD chain, they continue to collect photons and residual noise from nearby electrons. As a result, if these bits of 'data' in the form of electrons do not move past the cells fast enough, we're left with extra light in our images. This is most commonly visible in our everyday cameras through 'light smearing'.

FTCCD avoids much of this issue by including an area that is a 1:1 copy of the exposure surface, letting the electrons pass through with significantly less interference, but the catch is this new area is shielded from any light. This can be seen as the dark section of the CCD in Figure 3. Unfortunately, the cost of an FTCCD is close to double that of a standard CCD, as the sensor area is doubled and it requires more complex





Figure 5: The rolling-shutter effect from a CMOS sensor, created when the shutter and exposure is non-global. The shutter 'rolls' across the sensor area from one side to the other, causing strange results. A CCD shutter globally exposes the whole sensor at once.

electronics to function correctly. However for low-noise or low-light circumstances it can be a useful technology.

Advocates of the CMOS market argue that this is an issue that is solved in their technology, as CMOS by very definition doesn't require this migration 'down' the CCD from the bins after exposure. Rather, the NOT/NAND gate carts it away to the storage processing and imaging processing SoC immediately after capture. CMOS has its own disadvantageous quirk, however, in the form of rolling-shutter effects.

War's over, man.

The megapixel war (the density of pixels that could be packed onto a sensor for consumer-grade cameras) has now unofficially ended. Canon, Nikon, Leica, Pentax, Sony et al, all made it to the 21MP region with some sensors measuring up to 5616 x 3744 pixels in horizontal/vertical mappings. Something odd has happened since then, however. The high-end devices have actually scaled back since previous models, moving towards a more

conservative 18.x MP density, concentrating on sensor noise reduction with ever-improving CMOS technology.

Ultimately, the market is still divided into two camps. Those that believe greater and greater pixel density is required, because they are concerned with full scale prints at A2, A1 and A0, and those that believe printing doesn't matter and that noise is of more consequence. Logically, the nature of technology progression and the direction it has taken (and how happy it's made the consumers) depends on what part of the industry you ask.

In the sciences, the sky is still the limit, with companies striving for 100MP+ sensors in a mixture of EMCCD, CMOS and FTCCD technologies. This mixture of sensors has led to the idea of a hybrid sensor being created that combines the best aspects of both CCDs and CMOS. These new sensors have been tentatively called sCMOS (Scientific CMOS) and are currently found only in research labs and development environments. These new hybrid sensors feature some form of split-readout mechanism, in which the two halves of the sensor are read independently. Each column on the sensor is equipped with dual-column level amplifiers and dual analogue-to-digital converters. Because of this 'dual allocation' technology, it allows the sensor to support a switchable rolling shutter and global shutter mode. This then in turn alleviates the problems that CCD experiences with light-smear as a result of charge migration, but also mitigates the problems CMOS has with rolling shutter skew.

We don't think too many Atomic readers would leave the house without some kind of photon capture. We take it all for granted these days. Given time and some further market-trickle-down effects, these newest technologies that currently require liquid cooling, active fans and heat sinks, will make their way down to the consumer market, offering us even lower-noise sensors in even less-ideal lighting conditions, at a relatively reasonable cost. Now all we need to do is focus on making our sensors more intelligent, packing more capabilities onto the SoC, and spend towering piles of gold to improve the glass we put on the front of these photon-swallowing devices. (P) JC

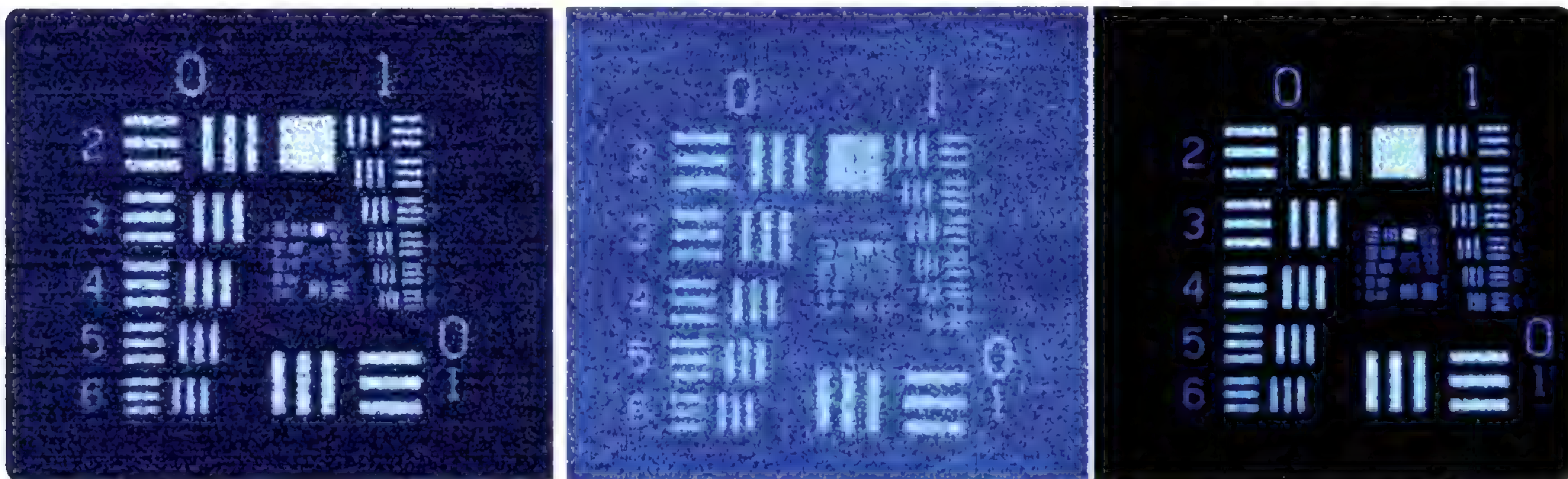


Figure 6: Comparison of an sCMOS sensor, an Interline CCD (ICCD) and a backlight illuminated EMCCD.

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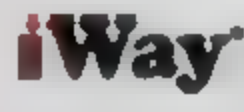
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I/O OF THE MONTH

A can of cable-worms

I How do cables tangle themselves, without any human interaction?

Network cables. Headphone cables. Power cables. Phone cables. Every kind of cable wants to be knotted around every other kind of cable, and only severe bondage and discipline can stop them.

Do they do it at night when you're not watching? Does mathematical "knot theory" have an answer?

Mariam Baird

Entropy never sleeps.



O I presume you're familiar with Raymer and Smith's 2007 paper,

"Spontaneous knotting of an agitated string":

<http://bit.ly/knotstring>

By tumbling many different strings in a rotating box, they found that the longer and more flexible a string, and the more room it has to move, the more prone to knotting it'll be. Surprisingly little movement can cause a knot to form, even in only one string; this accounts for the particularly irritating behaviour of headphone wires and telephone cords.

Knot theory itself isn't very useful here. It's spawned quite a lot of new mathematical ideas, some magnificently impenetrable theoretical physics that could help us make quantum computers, and some actual practical information for molecular biologists. But knot theory also deals with imaginary string that has no width, no friction and its ends joined together.

The concept of the "self-avoiding walk", which can basically be summed up as "Tron light cycles", is more relevant to real-world cable snarls and also things like the molecular folding, mountain-climbing ropes, umbilical cords and the numerous tubes and cables in a modern operating theatre. But still, from a mathematical viewpoint, the everyday multi-cable messes that bedevil us are often not actually knots at all. Instead, they're mere "tangles" which, if they were made out of frictionless widthless strings, would probably become much simpler or even disappear altogether if you just grabbed the ends and pulled.

Raymer and Smith's investigations are more relevant to the stuff behind your stereo or computer desk, but unless your cables are unplugged at both ends and your house starts rolling down a hill, your real-world situation won't much resemble their test environment either.

A big contributor to real-world cable snarls is that whenever you run a new cable, or unplug and replug an old one, you do a sort of randomised weaving around every other cable that's there. Without the nice perpendicular warp and weft and



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mathematically-proscribed sequences of overs and unders, weaving is a great way to make knots.

Further chaos can occur when you pull a cable through an existing wire-mess, and that cable has some sort of hook on the end of it, like the screws on monitor-cable plugs and those accursed little plastic clips on RJ phone and Ethernet plugs. Now, rather than random weaving, you're doing random *crocheting*, hooking other wires and pulling them through to wherever the cable you're pulling on is going.

Computer cables tend to be thick and stiff enough that they're not very prone to Raymer/Smith knotting, and flat cables, like SATA and phone leads, are less prone to tangling again, because they can only easily bend in one plane. But computer cable properties also make it very probable that just pulling on a cable will only make things worse.

Modern extra-flexible wires like those often used for earbud headphones are quite suitable for Raymer/Smith knotting, plus their own special problems if they're insulated with silicone rubber. It's tough and flexible and even highly fire-resistant, but silicone rubber also has a lot of frictional grabbing power, that helps it make crochet-like tangles and also helps knots lock together.

Cable-tangling can be greatly reduced, as you say, by keeping all of the wires under tight control. Don't use unnecessarily long cables if you can help it, remove cables that aren't connected to anything any more, and keep excess wire wound up and tied together. And tidy your room, and be home by ten. ☺

Keep the faith!

People often write in about recovering data from a dead hard drive by swapping in a brand new, un-fried circuit board from a donor drive; see www.dansdata.com/io075.htm, for instance.

In brief, this isn't a great idea, and when the problems with it are explained to them most people don't even try it. Or try, but fail. But every now and then, someone manages it. Someone like Georgie Millar, who featured in the I/O column twenty-nine issues ago (www.dansdata.com/io100.htm). The other day, he wrote in again:

Two years, four months and eight days ago, I sent an email regarding an accidentally destroyed 750GB Samsung HD753LJ that had been subjected to 12V on its 5V line and vice versa.

I've made a few attempts to recover the drive since then. The first was doing a board swap with a HD103SJ, the 1TB model. This spun up, but just did the "click of death". The board worked again on the 103SJ though, with no SMART errors, and that drive is still working to this day.

The second involved attempting to get my hands on another 753LJ, but the guy selling them didn't want to sell just one, and I didn't want to pay what he wanted for all five (I could have bought 1TBs for that price).

However, recently someone was selling three of them. I put in a bid for just one, but someone else wanted all three. I decided that since they so rarely come up and I needed this specific drive that I would pay more than the other guy, so I grabbed all three.

Got them all home and took a close look. Two of them were manufactured in 08/2008 and one was manufactured in 01/2008. My drive is an 08/2008 so that narrowed it down to two. Both controller boards were labelled with "TRINITY 32MB RE5 BF41-00206B R00".

The serial numbers matched all the way up to S13UJDWQ8, and the two I had differed only by 36860 and 36869, so I figured either was as likely to work as the other.

I unscrewed the board from the drive, and noted that the connectors matched exactly. Put the new board on, plugged it into power, and it spun up. No click of death. Plugged in the FireWire cable from the enclosure and the drive mounted and I saw my files.

So I plugged SATA into it, booted up my Mini-ITX board and plugged both in. It's currently copying the resurrected drive to the 2008/01 drive using GNU ddrescue and it's copied 87GB with 1 section of 385k unreadable so far (ddrescue will go back and split that section up when it's got the rest).

Oh, also, in case you're wondering, this drive's serial number is stored on the platter, not the controller board. The PC sees the serial number of the old drive.

Thanks for the advice!

Georgie Millar



This may be the world's first photographic evidence of a successful hard-drive brain transplant.

Goop-choosing

I was reading your thermal paste/compound review at www.dansdata.com/goop.htm and other than being interesting, it has sorta helped me decide on buying useless bric-a-brac from eBay.

I read your review, they're all pretty much the same you say, but I still need a little help here in choosing between three eBay thermal compounds. There's a "silver/graphite" silicone-based paste at \$2.90 delivered for a one-gram syringe, and some plain silver paste at \$4 for ten 1g syringes, and a big 30g syringe of grey silver-looking silicone-based goop for only \$2.50 delivered.

Which would you go for, or do you know of better ones at silly cheap prices? All in all, Diamond-bearing goop seems to be the best of the lot, but obviously way more expensive... So, I'm looking at these, they seem Ok... Intended use is to re-coat all the processors in the PCs and graphics cards I run (about 12 in total), and a couple of Xbox 360s.

John Maffysdad

Presuming that all of the thermal goops available at suspiciously low prices on eBay actually are what they say they are, it's possible that the fancy silver/graphite stuff will do something besides be electrically conductive enough to cause amusing problems if it gets on a circuit board. The listing John pointed me to said that goop was not at all conductive, but that might not be entirely accurate.

I'm really as in the dark as you here, though. Most claims of low bleed and high-temperature stability in thermal transfer compound are only relevant for higher clamping forces and *much* higher temperatures than CPU-goop has to endure. In reality, a goop that's easier for an amateur (a group which includes both of us) to apply in a properly thin layer is better than a thermally superior compound that's as easy to spread as refrigerated peanut butter.

I'm actually pretty suspicious of *any* allegedly-fancy thermal goop that sells as cheaply as these listings. Given the similar performance of all thermal goops for PC applications, anybody who mixes some graphite powder into normal white zinc-oxide goop will get good reviews for his "advanced" compound. But it won't necessarily actually be any better than the base material. And who knows what the base material for cheap eBay goops is.

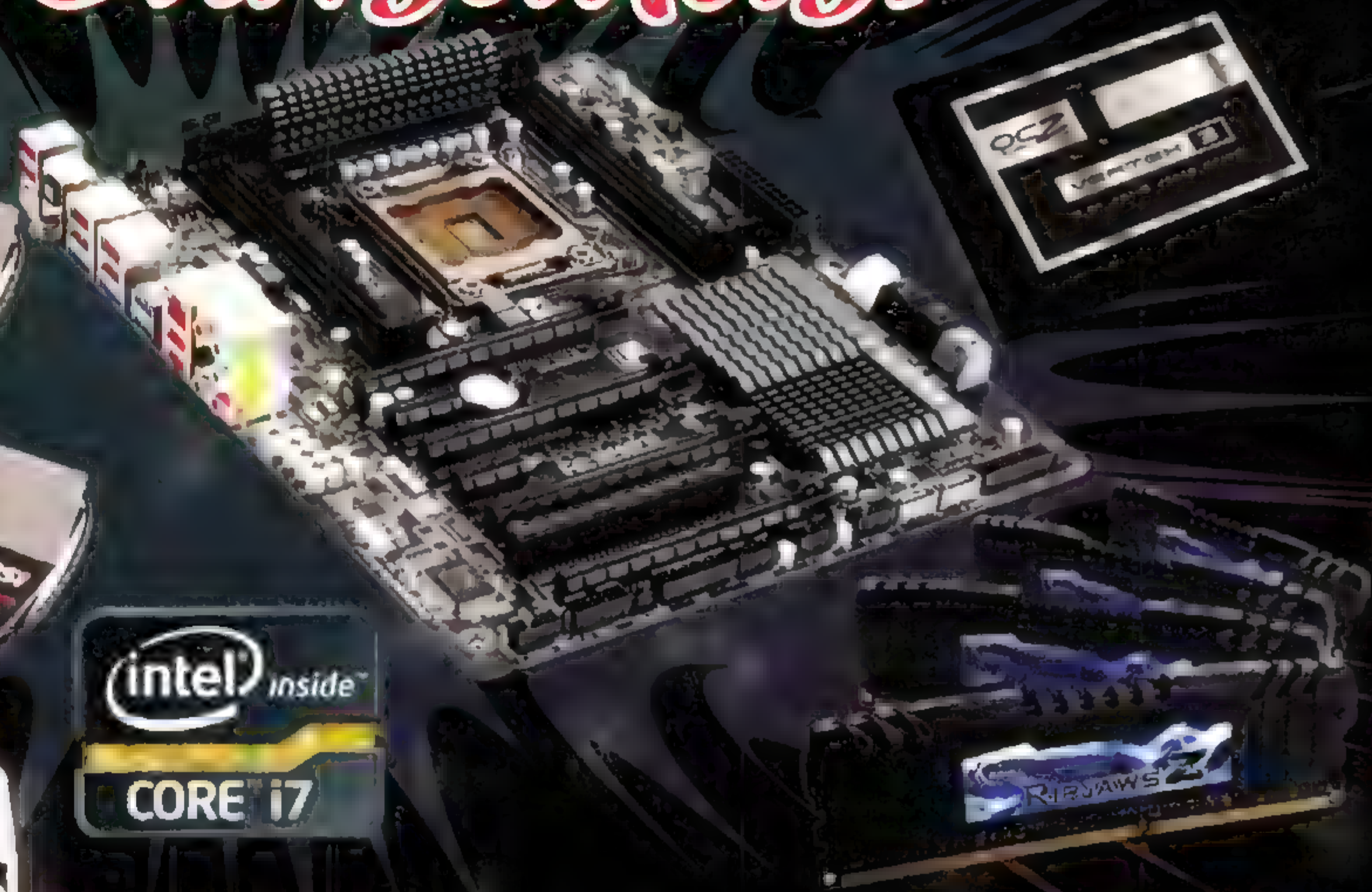
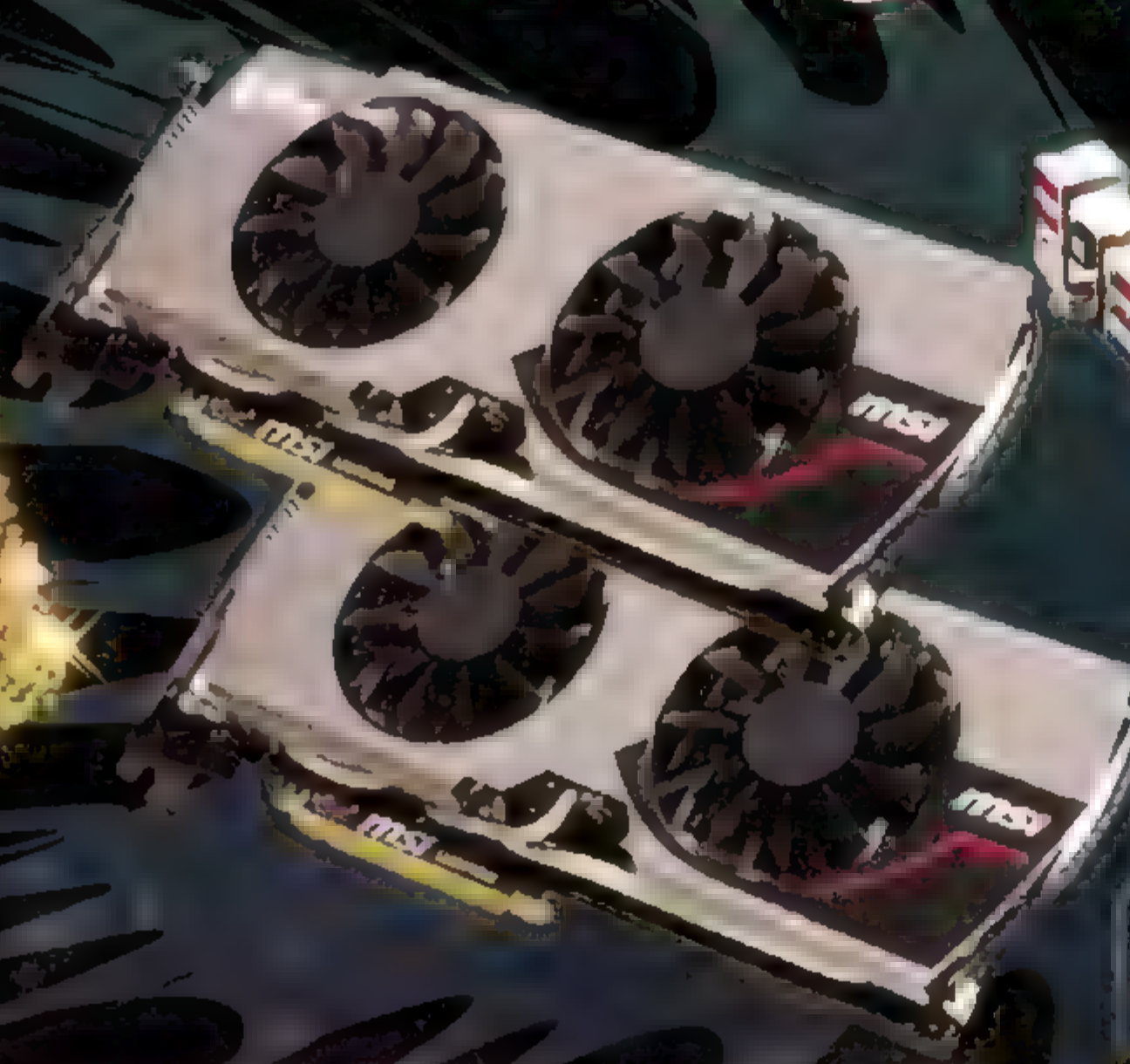
Given the number of chips you're gooping, a big thirty-gram tube would probably cover your needs and give you some spare for when you, inevitably, screw up. Personally, though, I'd just get a big tube of plain white zinc goop, do a few chips with it, and see if the delta-Ts under a given load actually improve; unless you're really pushing the overclocking envelope, any chip that actually needs re-gooping will give you better temperature results even if you re-goop it with boring white zinc compound.

It's not as if plain goop from your local electronics store is very expensive, either; ten grams of plain goop from Jaycar is only \$4.95, and 150 grams is only \$28.95.

Testing efficacy on an Xbox isn't very easy, of course, but you can make all sorts of numbers on a PC.

(If you've got a local computer store that assembles whole systems, by the way, then buying a new hard drive or something from them and asking them to throw in a handful of the spare thermal-goop packets and syringes that accumulate in the assembly area may be an economical option, and allow some comparisons!)

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The Skyrim Shitstorm

Ashton Mills likes his games functional and moddable.

I was there, when it began. Browsing the Bethesda forums, seeing what the gang was up to in de-constructing Skyrim's files for modding, when an update came down the pipes through Steam.

It wasn't what we expected: an update to fix the numerous bugs people had been experiencing, not the least of which were constant crash-to-desktops at the most inopportune times. These were so bad, in fact, that some people were unable to play more than five minutes between crashes and had shelved the game.

Until, that is, some users discovered that applying the LAA (Large Address Aware) flag to TESV.exe fixed most all their crash issues. This is a common trick used with many games to allow the game to see and take advantage of more than 2GB of memory, the default for a 32-bit application. Some savvy game developers, recognising people are using 64-bit Windows now and a majority have at least 4GB of memory, have started shipping their game executables LAA aware.

But not Bethesda, yet. And so a huge number of players were using a simple tool to set the flag for Skyrim and, as a result, were enjoying a crash-free experience for the clearly memory-limited game. Keep that in mind for a moment.

So the update streams down through Steam, and is it a long-awaited fix for all the crashing issues? No. Does it fix the numerous quest bugs or game balance? No. So what was the update for then?

DRM. To tie TESV.exe to Steam such that you need Steam running, like many Steam games, to play Skyrim. Oh and, in the process, making it impossible to now apply the LAA flag – modifying the .exe triggers Steam's VAC protection and stops the game loading.

Cue the inevitable shitstorm. Within 30 minutes a thread started filling up on the forums. Within an hour, there was 400 replies on one and over 600 forum members, let alone

unregistered lurkers, watching the thread. It spun on and on with rage, pain, and tears as gamers were unable to use LAA and their games were crashing left, right and center. Not to mention the update somehow invalidated some user's savegames, and mysteriously caused others to start experiencing worse performance problems than before.

And not a single word came out of Bethesda. The thread filled up to its limit, another was started, it too filled its limit, another was started... the shitstorm had continued for over 48 hours and is still going, and through it not one official response from Bethesda acknowledging the issues or even why the DRM was enforced at all – after all, as one enterprising forumite pointed out: to play the game you had activated it at least once, and to get the DRM update you had to have been using Steam in the first place – and how could it be sent to you if you didn't already own a legitimate copy through Steam? In other words, as with most DRM, it was bloody pointless and – along with breaking the ability to use LAA – this pointless dick move only inflamed the shitstorm more.

The irony is not lost on us that many users either hinted at, or openly admitted to, going to a torrent site and grabbing the pirated version – with its unaltered .EXE file of Skyrim – just so they could play their legitimately purchased copy again. It was also news to everyone following the thread that Skyrim was in fact originally DRM-free, news that had now been spread wide and far. Way to encourage further piracy. Bethesda, meet Streisand Effect.

Somewhere at Bethesda there is an executive, or cadre of executives, who are out of touch with their customers, and arrogant enough to not even address the problems they've caused. The lack of an official response in the forums has served to add fuel to the shitstorm and alienate the very customers who keep the company afloat. It doesn't take much to admit a mistake, or stand by your actions

by explaining why. Unfortunately the company remains silent.

I watched and read and felt for my fellow gamers, though I've been too busy working to actually start playing yet. Who knows what will happen when the next official patch comes with much-needed bugfixes, with the Steam DRM wrapper left in place, but it shows yet again just how pointless DRM is and that – always – it's legitimate users who suffer while pirates play trouble-free. And that, in turn, only encourages legitimate users to turn to piracy.

When I get around to playing I'll be using the DRM-free and LAA-enabled version, thank you very much. My Orc doesn't take kindly to being dropped to desktop mid-game, and you *really* don't want to see what he does to those who make him angry... (

Y U NO make sense, Bethesda?
amills@atomicmpc.com.au



WHERE DO ALL THE CALCULAT GO ?

Ben Hardwidge looks at the crucial role computers have played in our understanding of space.

ORF

From Orac to Holly, sci-fi spacecraft computers are often unfathomably intelligent stacks of circuits that can simultaneously navigate at the speed of light and delight in patronising the abilities of our puny human brains, but the harsh reality of spacecraft computers is that they're very simple machines.

For a start, the nature of preparing computer hardware for life in space means that it will never be high-tech compared with the computers we use on Earth. The Hubble Space Telescope is based on a well-aged Intel 486, for example, and the International Space Station's command and control computers are based on 386 chips (complete with old-school 387 maths coprocessors).

While the on-board computers in spacecraft rarely feature cutting-edge technology, they still play an essential role in space flight. "The processes handled by flight computers are virtually the same for all spacecraft," explains NASA aerospace engineer Edward Brinker, who goes on to say that these computers have five main jobs. These include monitoring for faults, sending data and status information to the ground computers, and processing uplink commands from the machines on the ground. In addition to this, the spacecraft computer will also have to monitor and maintain the temperature of the craft, for which it has thermal sensors, heaters and cooling systems at its disposal.

Of course, the other main job of a flight computer is getting the craft from A to B, using navigation and control. Brinker explains that this involves "reading the altitude and positional data from the sensors, and sending commands to the reaction wheels, magnetic torquers and thrusters to manoeuvre the spacecraft."

Start your engines

The bright-eyed young squirts among you might not remember the pre-Pentium days, when Windows was still a clunky front-end for DOS with no Start button or Taskbar, and when Doom was a technological marvel rather than a pixelated eyesore. Back then, we became excited about 8MHz increases in clock frequency, and it was worth saving \$200 for an extra 1MB of RAM. Such kit may be rightly mocked by today's smartphone generation, but above our heads right now, a lowly 486 is still controlling the source of today's most spectacular images of space: the Hubble space telescope.

That's to be expected, you might think. After all, Hubble has been sitting in space since 1990, and the 486 was relatively commonplace then, but the 486 was actually the third major upgrade to Hubble's computer system. "The original Hubble computer was a DF-224 made by Rockwell International, which was one of a series of military computers," explains Brinker.

The DF-224 is an archaic relic of computing history. Its mainly redundant architecture was fundamentally based on 2-bit 'slices' – the idea being that you could combine eight of these to create a 16-bit computer. It didn't even use solid-state silicon memory, instead using plated wire

It's computing, Jim – but not as we know it.



to store random data. It was also based on early PMOS (p-type metal-oxide semiconductor) logic, rather than the more sophisticated CMOS logic used in silicon circuits today.

"PMOS was a very early logic, which consumed a lot of power, and this created some cooling problems for Hubble," says Brinker. What's more, he tells us, the plated wire memory was "fragile and from time to time would lose the capability to access whole bit planes."

The first answer to this was to complement the DF-224 with a co-processor. This wasn't a standard upgrade for the DF-224's architecture, but Brinker explains that "access ports were available to the bus for testing purposes." This access port provided NASA with a means of adding another processor, and at the time of Hubble's first servicing mission (1991), the 386 was an appealing candidate for the job.

"In 1991, the Intel 386 was among the more powerful computers available," says Brinker, "and we'd learned that it was somewhat radiation tolerant." Since adding a non-active co-processor

to the DF-224 wouldn't degrade Hubble, the decision was made to add the 386 co-processor during Servicing Mission 1. "After installing the co-processor, it was turned on and the flight software was converted from the DF-224 to the 386 one routine at a time."

This was an improvement, but there was no avoiding the fact that it was still basically a hack. "I realised that the co-processor was an inelegant solution that left us ultimately subject to failure of the DF-224," admits Brinker, and in 1994, he decided that the time had come to upgrade Hubble's computer system properly.

"In a 1994 issue of the now defunct magazine Micro Design, there was a paragraph about a QML (qualified manufacturer listing) version of an Intel 486," says Brinker. "We were radiation-testing possible replacements to the DF-224/386 and we decided to test the 486. We found that the 486 was one of the more radiation-tolerant processors, so we performed an additional radiation test to confirm that our initial test results were correct."

Hubble's 486-based computer (the black box on the bottom right) was installed during a ten-day mission.





The results looked good, and NASA then decided to go ahead and replace Hubble's DF-224/386 combo with a 486. As with everything in space, though, you couldn't just send up a Shuttle and crew to replace the computers immediately. The kit had to go through a number of steps before Hubble's computer was fully replaced, which Brinker lists here:

We purchased a lot (100 I believe) of Intel OML 486 chips.

- The lot was radiation tested again.
- The lot was electrically tested.
- The lot was PIN tested (rotated on a vertical table), while we listened for particles floating in the chip.
- About five of the parts were de-lidded and mechanically checked – this means that wire bond pulls were made to verify that the wire-to-pad connections had sufficient strength.
- The proposed 486 system requirements were presented to a review committee to prove that we fully understood all of the proposed functions of the 486.
- A proposed preliminary design was prepared to prove that we had correctly met all of the requirements.
- A critical design was prepared to prove that we had accurately implemented the

Jodrell Bank's Hydra Computer

How 360 quad-core Xeons are measuring the effects of general relativity.

You may think your quartz watch keeps good time, but our wrist-mounted timepieces are nothing compared with the predictability of some pulsars. These are spinning neutron stars that send out electromagnetic radiation.

The pulsing effect after which they're named comes from the regular, predictable way in which the stars spin. We can only observe a pulsar's radiation when it points at our planet (this is the pulse), but the dense nature of the stars means this occurs on a very predictable basis. In fact, with some pulsars, the predictability of pulses is as precise as an atomic clock – several million years would have to pass before you even lost a second.

This has intrigued researchers at many observatories, including the UK's radio telescope observatory, Jodrell Bank, which is part of the University of Manchester. It has several high-performance computing setups, but the flagship Hydra computer was built specifically for monitoring the behaviour of pulsars.

It features 180 nodes, each with a dual-processor motherboard and two 2.66GHz quad-core Xeon chips. Each node has 4GB of RAM, but the head of computing, Dr Anthony Holloway, says he's in the process of upgrading around a quarter of the nodes to 8GB.

Hydra is used for several tasks, but Holloway says one of its main roles is

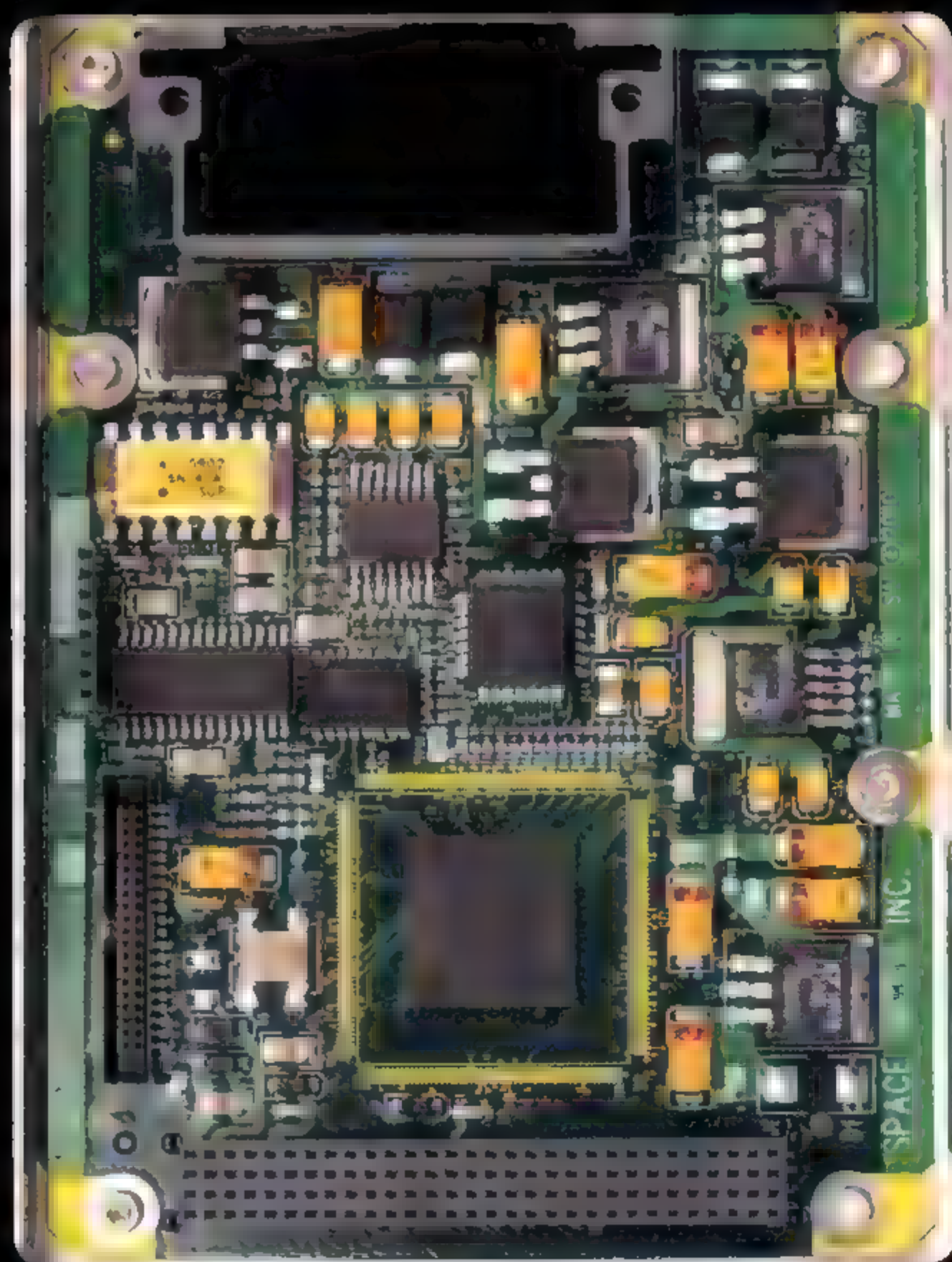
recording accurate measurements of the times between pulsars. "The data needs to have a very high signal-to-noise ratio, and needs to be very high quality, so you get a really accurate timing measurement of these pulses," says Holloway. Hydra's job isn't just to measure the timing of regular pulses, but also to spot any subtle changes or effects, such as the effect of two pulsars spinning around each other. "If you find two of them going around each other, it's like having a way to measure the effects of general relativity," says Holloway. He describes an experiment where the time on an atomic clock on the ground was compared with that of an atomic clock on a plane flying round the Earth. "The time was different," he says, "and that's due to the fact that one was travelling at speed relative to the other, so you can see it on the Earth – that's pretty low-level gravity – but it's much more extreme in space.

"If you see pulsars arriving earlier in one direction, but then 90 degrees to that, they're slowed down, you know there's a further gravitational pull: the wave has disturbed space time in that area."

According to Holloway, Einstein's predictions are currently "right at about a 99.55 per cent sort of level," and with further research, our understanding of relativity will become more refined and even more accurate.

Jodrell Bank's Hydra computer has 1,440 CPU cores working together to examine the behaviour of pulsars.





This Space Micro power battery management PCB has been 'hardened' to survive space conditions.

proposed design.

- Parts purchased, boards and chassis designed and manufactured.
- Component-level testing.
- System-level testing.
- Verification of design requirements.
- Environmental testing.
- System testing.
- Flight installation procedures.
- Verification of installation procedures.

Brinker admits that he's probably still left out a few steps, as the process of installing or upgrading spacecraft hardware is incredibly complicated.

"It's a long process to implement flight hardware," says Brinker, "which usually takes three to four years to complete. A 'state-of-the-art' computer will be obsolete at the end of the process. The 486 is still in use on Hubble."

One hard mother

You only need to look at the multitude of discarded PCs every council cleanup to see the grizzly fate that can befall the less fortunate computer components on our own sheltered planet, but computers face much more worrisome challenges out in the ether.

This is because the Earth's atmosphere acts as a big bubble that shields us from high-energy and ionising radiation that spacecraft face. High-energy particles are charged so strongly that they can pass directly through or into matter. Computers on Earth don't need to worry about high-energy particles from solar winds, or serious disruption from background cosmic rays. However, if you were to send your standard desktop PC rig into space it would quickly start to become confused, assuming it even survived the launch. It only takes a single charged particle to disrupt crowds of electrons in a circuit, resulting in electronic noise and spikes, which ultimately lead to jumbled and imprecise data and results.

"Radiation tolerance is one of the major problems in space-based electronics, not just

Magnetic Memory

Spacecraft computers didn't start to use silicon memory as standard until the 1990s.

Over 40 years have passed since Intel introduced its first silicon DRAM chip, the 1Kb 1103, but it wasn't until the early 1990s that silicon memory became standard in spacecraft.

Silicon presented problems for spacecraft when it was first introduced as a material for integrated circuits. For a start, it was volatile, which means it required a constant power supply to retain its data. It was also susceptible to electromagnetic interference and radiation. As such, it isn't surprising that the first Shuttle missions didn't use silicon memory. But at that time, the alternatives to silicon were the now-archaic relics of room-sized computers.

The first Shuttle missions used ferrite core memory, which was the standard form of memory for computers from the mid-1950s and throughout the 1960s. This is based on small magnetic rings (the cores), with wires woven through them to enable magnetic data to be stored. Ferrite core memory was primitive but effective, as each core only needed to act as a single binary switch, representing just a single bit of data.

However, ferrite core memory also had its problems with regards to spacecraft, as it

was particularly fragile, which is far from ideal in a computer that has to survive a turbulent launch process. By the end of the 1970s, the limitations and fragility of ferrite core memory clearly needed to be addressed, but this still didn't herald a move to silicon memory.

The next step was plated wire memory, another development from the antiquated computers of the 1950s. Like ferrite core memory, plated wire memory stored data magnetically, but it instead stored bits on a grid of copper wires, which were wrapped with slivers of film made from an iron-nickel alloy called 'permalloy'. Each wire represented a single bit, while each wrap of film acted as a word. For example, if you had four wires and five wraps of film, the memory could store five 4-bit words.

Believe it or not, plated wire memory was still used on NASA spacecraft computers in the 1990s, including the Hubble Space Telescope. It was only shortly after the beginning of the 1990s that silicon memory started to be used in spacecraft. By then it could have superior error-checking capabilities, and sturdy silicon-based SRAM modules circumvented many of the original problems with volatile DRAM chips.

The computers in the first Shuttles, such as the original STS-1 pictured here, used magnetic core memory rather than silicon.



computers," explains Brinker. According to Brinker, knowledge of the radiation levels that will be present in the environment is a crucial design criterion for a mission. Low Earth orbits (within 2,000km from the Earth's surface), such as those used by satellites, involve only a mild amount of radiation, while missions over the Earth's poles have high requirements. Meanwhile, the radiation

levels of deep space missions sit somewhere between the two extremes.

The solution to this is what's known as space or radiation hardening. This is a series of methods that enable computers either to deflect radiation, or to at least correct the resulting errors. Brinker lists four hardening methods, the first of which is simply by design, meaning that the specific

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design of the hardware makes it better equipped to deal with the threat of radiation. He provides the example of using hardened SRAM (static RAM) with six-transistor cells, rather than the DRAM chips we use, which have a single transistor and a pair of capacitors in each cell.

The second is by process, where the method of manufacturing the hardware and the materials used help to make a component more resistant. For example, chips manufactured with insulating substrates are more resistant to radiation than standard silicon chips. Brinker gives the example of the Silicon on Insulator technology used today by companies such as Intel and IBM as a process that's appropriate for space-hardened circuits.

Then there's what Brinker calls the implementation method, where error detection and correction logic can be "used to scrub memory by reading out each cell and rewriting the corrected data." Finally, there's also the good old-fashioned method of simply surrounding the chips with a shielding material such as aluminium or tantalum, a process that Brinker simply calls the protection method.

Science needs you!

You've probably already seen some of Hubble's most spectacular images of space. The Pillars of Creation shot and the Ultra Deep Field snap regularly pop up, and they're incredible sights too. However, Hubble is a lot more than a pretty picture factory. As Douglas Adams once noted, space is really big, and there's so much about our universe that we can't observe from Earth, and there's also only so much time that scientists at NASA can spend poring over the many images snapped by Hubble.

This is where you can help. The Galaxy Zoo project (www.galaxyzoo.org) aims to take advantage of human pattern and shape-recognition abilities, which are often superior to those of even sophisticated computers, to look through the myriad photos that come from Hubble, and help to classify a million previously unclassified space objects.

Galaxy Zoo gives you a chance to discover previously unknown objects in space, and some

Hanny's Voorwerp is just one of many new objects discovered by amateur astronomers using Galaxy Zoo.

remarkable discoveries have already been made. These include Hanny's Voorwerp (pictured), and the existence of pea galaxies – tiny galaxies that are forming stars at an extremely rapid rate.


The project has already changed our understanding of galaxies. "The peas and Voorwerp are supercool," the project's forum administrator, Alice Sheppard, told us, "but I have another favourite aspect, and that's the large-scale discoveries. For example, we now know that ring galaxies are common, when they were previously thought to be rare, and how the shapes and positions of galaxies determine their other characteristics, such as star-forming rates.

This would never have been found out were it not for such a huge data-search."

According to Sheppard, users of Galaxy Zoo also gain a great sense of reward from taking part in the project. "There's a special thrill to making a decision about an object so far away. Why is it that shape? What treasures might it be hiding? Am I saying something is a boring blob when it might even contain life?"

She also recommends the forums, which regularly contain interesting and informative discussions. "A social worker in the USA once said that Galaxy Zoo was an antidote to the despair she felt with the world doing her job," says Sheppard. "I know I've found most of my best friends through here – it's like meeting members of my own species. We never run out of things to talk about!"

Of course, Galaxy Zoo is just one of the many ways in which you can use your computer to make discoveries in space. The similar Moon Zoo project (www.moonzoo.org), for example, aims to gain a better understanding of the surface of our own local orbiting rock. Much like Folding@home, there are also plenty of astronomy-related distributed computing projects, including Einstein@Home (<http://einstein.phys.uwm.edu/>) and MilkyWay@home (<http://milkyway.cs.rpi.edu/milkyway/>), both of which can take advantage of GPGPU computing.

Whatever you choose, just keep in mind how little computing power they get by with up amongst the stars. 



The LOFAR Tesla Cluster

GPGPU computing applications in astronomical research.

While the computers used on spacecraft might be the silicon equivalent of the gramophone, the computers used for astronomical research on the ground are comparative juggernauts. Crunching through thousands of terabytes of radio telescope data isn't easy for a computer, which is why machines such as Jodrell Bank's Hydra (seen earlier) need so much computing power.

Hydra is based on Intel Xeon chips, while many other astronomy super-computers are based on Blue Gene chips, but is there any potential to use GPGPU computing instead? The researchers at LOFAR (low-frequency array for radio astronomy) are finding out.

Postdoctoral fellow Panos Lampropoulos is involved with a LOFAR project to detect the Epoch of Reionisation (EoR). "It looks like Swiss cheese holes, with the background being neutral hydrogen," he says. "This is the signal of ionisation 'bubbles' around the first sources, be it stars, black holes or even dark matter particles and cosmic strings."

It's possible to observe EoR signals with a radio telescope, and as Lampropoulos explains, the principle is that "neutral hydrogen emits a certain spectral line while the ionised hydrogen doesn't, so there should be patches of emission or no emission correlated with the radiating sources." According to Lampropoulos, "by using such observations one can infer the properties of the first structures in the Universe."

It's exciting stuff that could help us understand the development of some of our Universe's first structures after the Big Bang, but it isn't easy. For a start, the signal is very weak, and Lampropoulos says that detecting the signal can be hampered by bright galactic and extragalactic foreground sources, ionospheric distortions, and interference generated by terrestrial or satellite sources.

This is where the need for high-performance computing (HPC) comes in. "In radio astronomy, increasing sensitivity translates into observing time, which translates into accumulating huge amounts of data," explains Lampropoulos. "In the case of LOFAR EoR, this translates into 600 hours of data split over 100 nights of observation – six hours per night. The effective data set size will be of the order of 1.5 petabytes."

Not only does LOFAR's computer system need to store and process this colossal amount of data (in effect, 1,536 terabytes), it also needs to produce images from it, and this is what really milks a computer's

processing power.

"In order to produce images from the raw data you have to use computationally expensive imaging techniques, which are usually termed as 'maximum likelihood' or 'optimal map-making'," explains Lampropoulos. In terms of processing power, he says this amounts to 1,021 FLOPS. "If you have a 100 TFlop dedicated supercomputer," he says, "this would require 140 days of analysis, assuming 10 per cent efficiency compared with peak performance."

Traditionally, LOFAR uses Blue Gene-equipped HPC rigs, but the group has been experimenting with GPGPU computing for imaging, including the purchase of an 80-node cluster in which each node features a pair of Nvidia Tesla C1060 GPGPUs. The cluster is used for imaging using a variety of different algorithms for different observational scenarios.

Using GPGPU computing, Lampropoulos says that LOFAR "demonstrated that we reach almost 25 per cent of the peak performance for double precision operations and 44 per cent for single precision arithmetic." However, he notes that the latest-generation Fermi GPUs are better at double-precision operations.

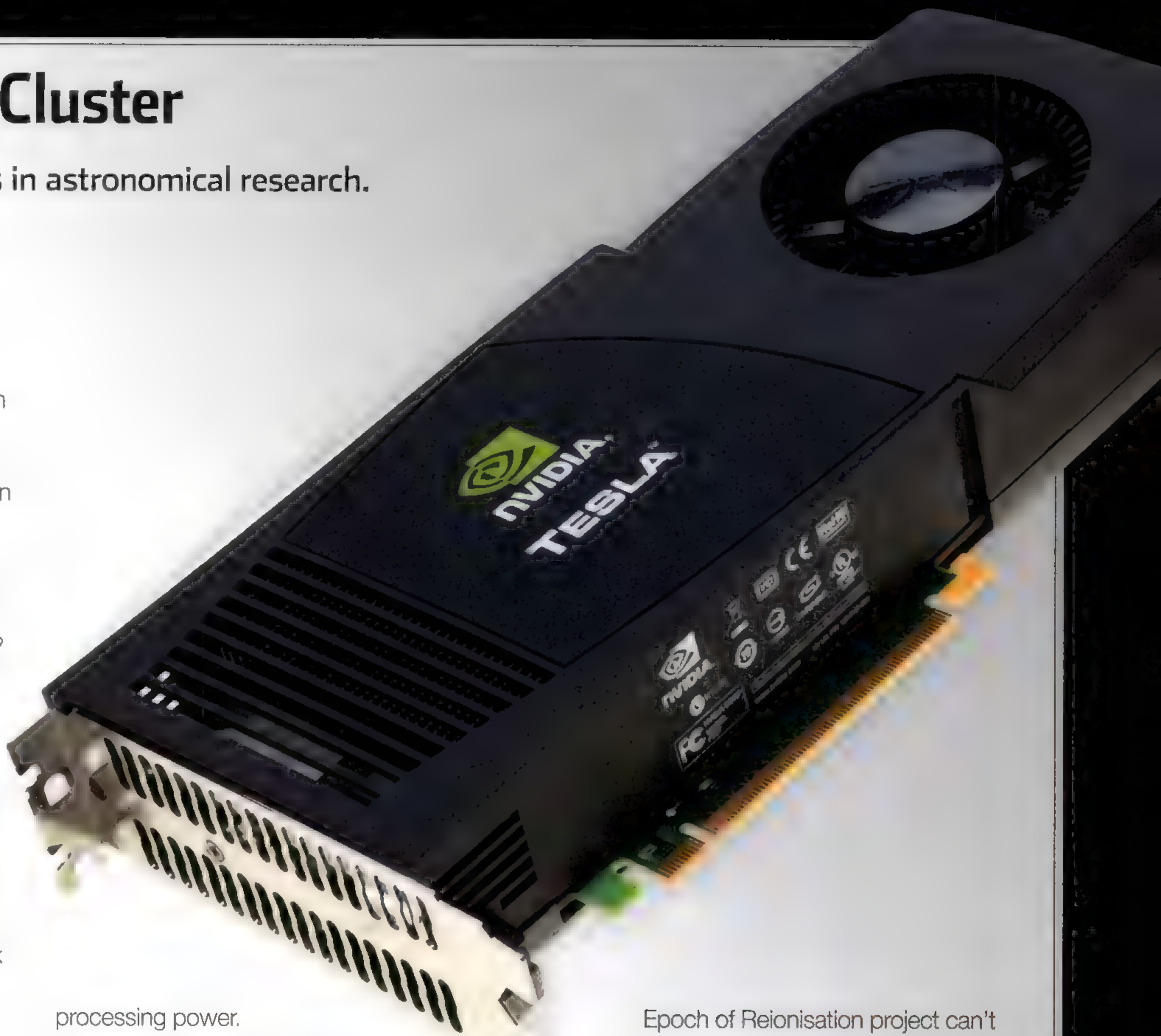
The results are mixed, and largely depend on whether your code can be effectively parallelised across a GPU's stream processors. For example, the work on the

Epoch of Reionisation project can't be completely parallelised, so the Tesla cluster doesn't offer a major performance boost over a Blue Gene system; however, Lampropoulos notes that the GPU rigs contain more memory per node than a Blue Gene rig, and are also cheaper and generally more energy-efficient. So even without a significant speed gains, the Tesla cluster is still well worth using.

LOFAR has also found the Tesla cluster useful in other areas, such as FFTs and linear algebra calculations, as well as holographic projection (correcting for non-isoplancticity of the LOFAR array due to the curvature of the Earth). Depending on the application used and the level of optimisation, Lampropoulos says LOFAR has seen speed increases of between 5x and 12x from the Tesla cluster.

"There's a lot of hype about GPGPUs nowadays," says Lampropoulos. "Some problems can benefit significantly from the use of GPUs, while others don't. In the case of the LOFAR EoR, we've shown that we can use GPUs as an efficient and cost-effective platform that will allow us to engage in exciting new science and explore the furthest reaches of our Universe."

When the project is complete, Lampropoulos says LOFAR will make a slideshow movie of the first moments of cosmic structure formation, so keep an eye on the website at www.lofar.org





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HARDWARE

NEWS, REVIEWS AND ROUNDUPS ON THE LATEST HARDWARE

Bulldozer last month, and now it's time for Intel's turn: Sandy Bridge-E has hit the Labs and we've given it a full spankinating, paddling it through our bevy of benchmarks for your viewing pleasure. While it's not going to set the world aflame, it's certainly a nice speed boost.

We follow the new chip up with a super-premium mobo from GIGABYTE that's well

worthy of being paired with such a fast processor, and a graphics card from ASUS that is actually quite mind-boggling. If you've never sat down and said "I wish my graphics card was two graphics cards instead" then you've come to the right place.

And we've got a huge Head2Head that rounds up the cheapest chips for your summer build!

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Intel Core i7-3960X

Undoubtedly the quickest CPU to date, but will you even notice?

Street Price \$12505 **Supplier** Intel

Website <http://tinyurl.com/i7-3960X>

Specifications 6 x 'Sandy Bridge-E' CPU cores @ 3.3GHz (3.9GHz Turbo); 64KB L1/core, 256KB L2/core, 15MB L3 shared; 130W TDP; integrated Northbridge; Unlocked Multiplier; DDR3-1333 quad channel memory controller; 32nm HKMG process; Socket LGA2011

When Intel launched its enthusiast Nehalem architecture processors, codenamed Bloomfield, alongside Socket 1366 way back in 2008 it marked a significant departure from the way in which the company had historically managed its Extreme Edition processors. No longer would they share a socket with the mainstream; instead the high end enthusiast lineup would have its own, fancier platform.

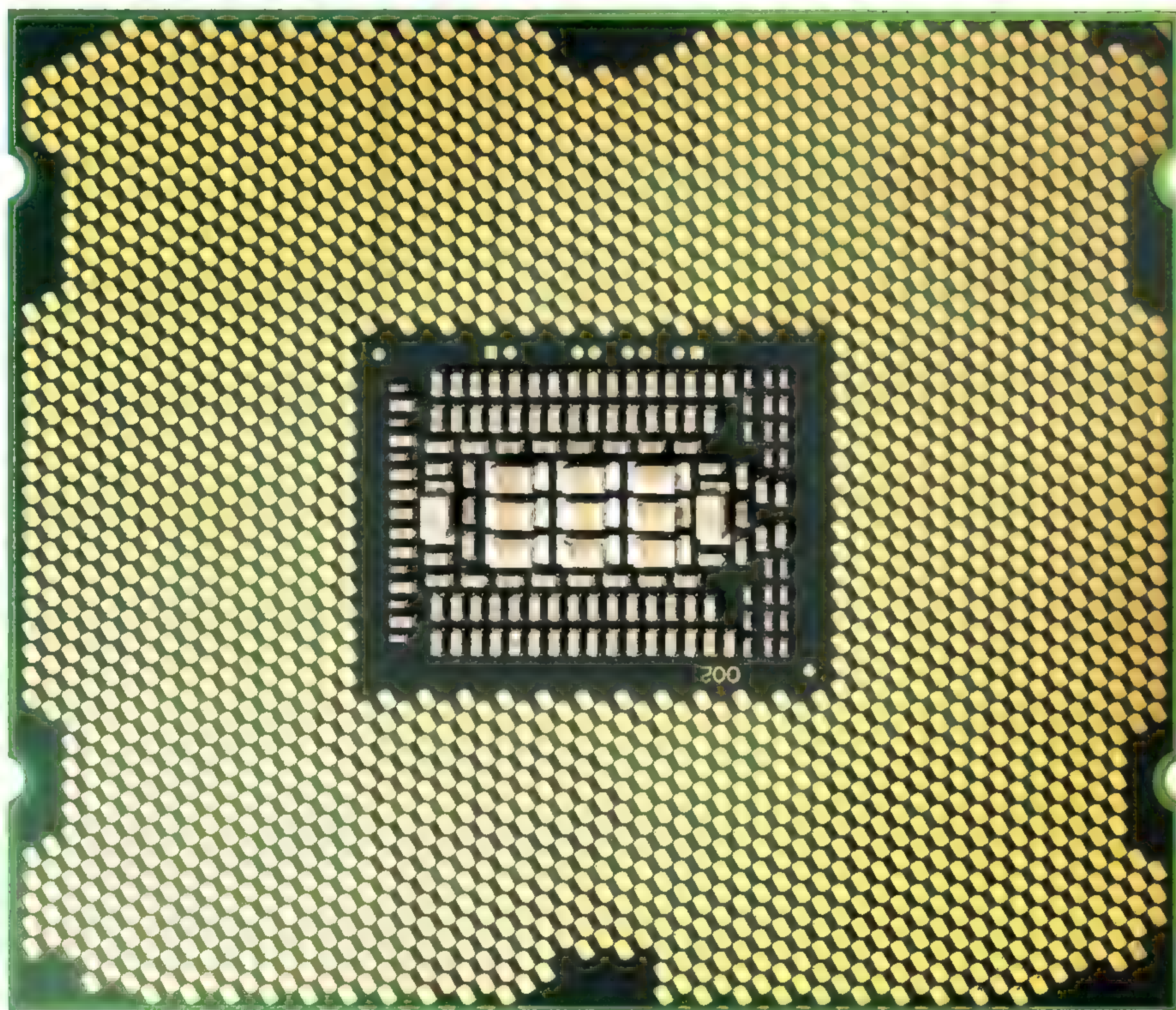
Thanks to follow-up Westmere CPUs like Intel's Core i7-980X and -990X, the LGA 1366 platform and accompanying X58 chipset have had a long and fruitful life. But like all good things they are now obsolete, replaced by the new flavour of Extreme, the Core i7-3960X. Known as Sandy Bridge-E, this new CPU takes on all the hallmarks of an Extreme edition. Priced around \$1250 (which doesn't even include a cooler), it is the fastest CPU in Intel's lineup and has support for a bunch of exotic features.

For the 3960X Intel has taken its upcoming Xeon design, and locked off two of the cores. This leaves six cores running at a non-turbo frequency of 3.3GHz, spiking up to 3.9GHz. It also means that the processor has a quad channel memory controller, 15MB of L3 cache and theoretical support for PCI-Express 3.0.

It is also more overclocker-friendly than standard Sandy Bridge processors. With the Sandy Bridge architecture Intel linked all of the internal speeds to a single clock generator in the CPU. This meant the end of bus-based overclocking for the standard processor lineup, with end users being relegated to playing with the multiplier on the unlocked -K variants of Sandy Bridge.

What's new

With Sandy Bridge-E Intel has added limited ability to overclock the CPU via the bus. This isn't the kind of granular speed control that the FSB



or QPI offered; rather the bus can be switched between preset levels of 100MHz, 125MHz, 166MHz and 250MHz. This new speed only applies to the signal being sent to the CPU, and it is still somewhat inflexible considering what has been possible in the past.

These new features all sound pretty impressive, but the reality is that Sandy Bridge-E is less important than Bloomfield was when it launched. Bloomfield predated the normal desktop versions of the Core series processors, which enhanced its position as the go-to performance solution. This time around, Sandy Bridge-E has arrived almost a year after the mainstream Sandy Bridge processors, which deliver more than enough performance for the majority of PC owners.

Where Sandy Bridge-E shows value is in specific areas and for specific usage models.

This is much more of a workstation platform than one for gaming or light use. The extra memory bandwidth provided by the quad-channel memory controller, as well as a prevalence of motherboards with eight DIMM slots, mean those undertaking memory-hungry workloads will love what the 3960X brings to the table.

As will those with serious SLI or Crossfire addictions. The PCI-Express controller has 40 lanes directly to the CPU which allows for two graphics cards to be used with full x16 connectivity, or four cards with x8. This is without the need for third party PCI-E bridges getting in the way, which makes activities like overclocking a lot smoother as well as maximising multi-GPU bandwidth.

The PCI-Express controller also technically supports PCI-Express 3, although Intel has been quite vocal in stating that it won't officially

Sandy Bridge E Models

| CPU | Base Clock Speed | Max Turbo | Cores/Threads | Cache | Official Memory Support | TDP | Socket |
|-------------------------------|------------------|-----------|---------------|-------|-------------------------|------|--------|
| Core i7-3960X | 3.3GHz | 3.9GHz | 6/12 | 15MB | Quad Channel DDR3-1600 | 130W | 2011 |
| Core i7-3930K | 3.2GHz | 3.8GHz | 6/12 | 12MB | Quad Channel DDR3-1600 | 130W | 2011 |
| Core i7-3820 (due early 2012) | 3.6GHz | 3.9GHz | 4/8 | 10MB | Quad Channel DDR3-1600 | 130W | 2011 |
| Core i7 2700K | 3.5GHz | 3.9GHz | 4/8 | 8MB | Dual Channel DDR3-1333 | 95W | 1155 |
| Core i7 2600K | 3.4GHz | 3.8GHz | 4/8 | 8MB | Dual Channel DDR3-1333 | 95W | 1155 |

support the new interconnect version without graphics cards to test it with. This very lack of graphics cards indicates that PCI-Express 3 is still some years away from being a must-have, so while support is nice, it is by no means a selling point.

While there are certainly interesting new technologies within the Sandy Bridge-E architecture, the same cannot be said of the accompanying chipset, the X79. This has virtually the same feature-set seen on the mainstream P67, with no native USB 3 support and a measly two SATA 6Gbps ports. At Computex we saw X79 motherboards with support for Serial Attached SCSI drives, however these are now nowhere to be seen, despite the RAID controller coming from a family that supports SAS (you need to use Intel's enterprise driver to configure them anyway, so why not support an enterprise SAS feature?).

It's fast. But is it good?

Intel's biggest problem with the Core i7-3960X is finding a suitable market for it. Most gamers are going to get very little from the Socket 2011 platform, largely because the current socket 1155 Core i7 and i5 CPUs are more than capable of the tasks required of them. Games are primarily designed for consoles, which

PCI-Express 3 is still some years away from being a must-have, so while support is nice, it is by no means a selling point.

are generations behind in CPU technology. This makes increases in CPU grunt a lot less noticeable in games than other applications.

As an example the 3960X delivered very similar Crysis framerates to the Core i7 2600K when we used the same GTX 580 card. There are a myriad of things that would make your gaming better before you even considered Sandy Bridge-E.

Overclockers will certainly get something out



of the new platform, although the cheaper non-extreme 3930K CPU comes in at half the price and is likely a better option for those wanting to get familiar with Sandy Bridge-E overclocking.

You can see our overclocking results in the G1. Assassin 2 review on the next page. Using a 16GB kit of G.Skill Ripjaws Z, the Gigabyte G1 Assassin 2, Intel 710 SSD and a 3960X we were seeing clocks of up to 4.45GHz out of the CPU. So while this doesn't have the potential for ridiculous frequencies seen with AMD's Bulldozer, it does have the potential to kick some serious butt in benchmarks.

Where we do see potential is in CPU heavy workstation applications. For rendering or video the 3960X excels thanks to the inherently CPU-bound nature of these workloads. In Cinebench for example, we were seeing multithreaded scores of 10.55, almost double what we see with AMD's Bulldozer FX-8150.

It's lonely at the top

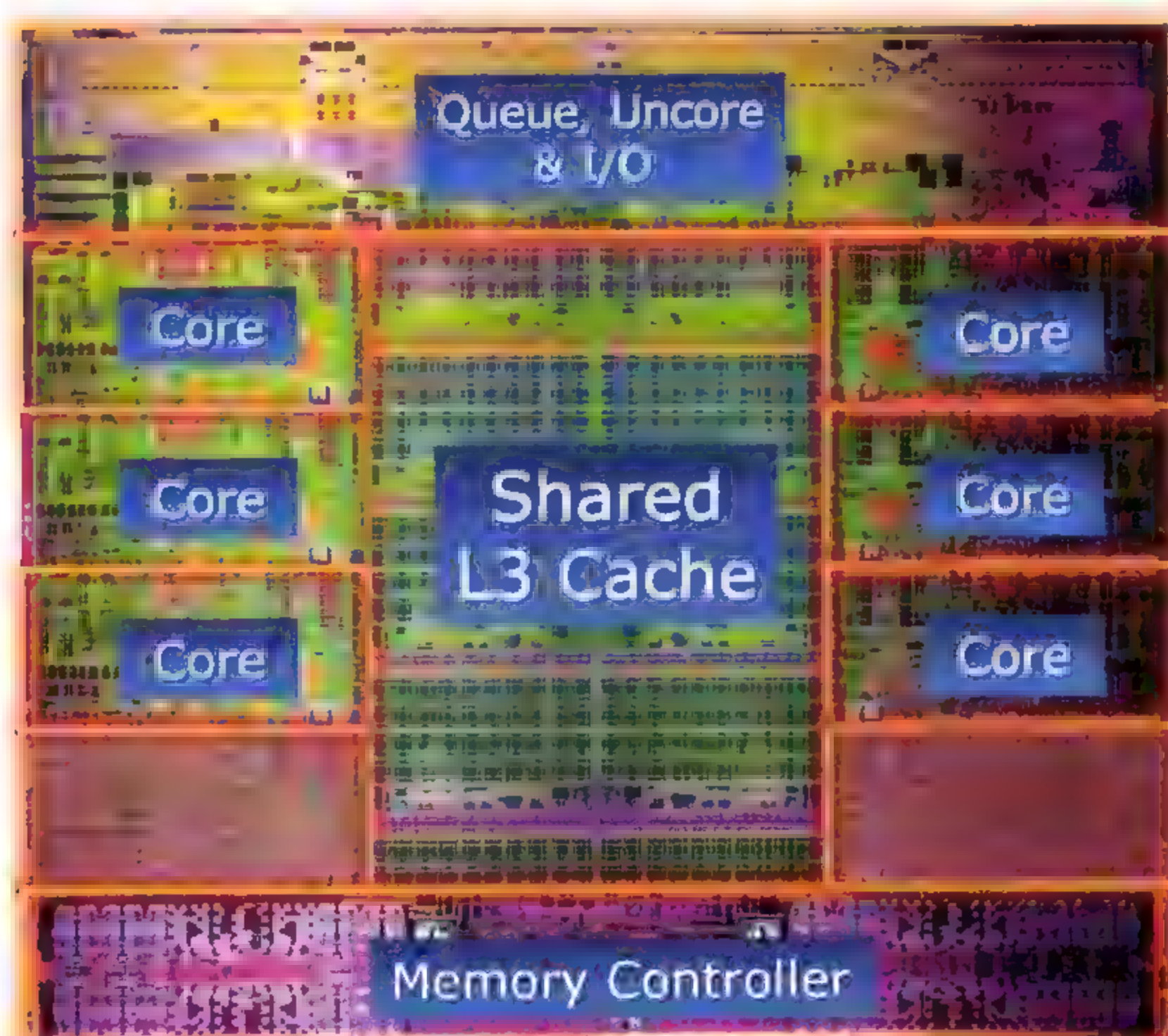
Herein lies our problem with the 3960X: it is an astonishingly fast CPU, at times 25% quicker than the top end of the normal Sandy Bridge lineup. However this is performance

over and above what the average enthusiast will need. It has sex appeal for sure, but to mere mortals it just isn't worth the premium pricetag involved.

As a gamer there are many more wonderfully extravagant ways to spend if you have money to burn. Multiple GPUs or monitors are just some of the tangibly beneficial ways to not buy a 3960X. With the CPU costing around \$1250, decent motherboards starting around \$400 and RAM kits starting at \$120ish and going way up from there you're looking at a massive outlay to get the same sort of performance that you could get from a Core i7-2700K system.

For now this platform is only really worth considering if your need for CPU grunt outweighs your need to save money. Even if we look beyond the \$1250 3960X, the \$650 3930K is still going to set you back a lot more than a socket 1155-based system would. Come next year Intel is planning to launch a quad-core variant of the architecture, which might make things a bit more reasonably priced. But despite the fact that this is clearly the best CPU on the market, we struggle to find a reason to pay the price that Intel is asking for it. **JG**

Intel Core i7-3960X Processor Die Detail



GIGABYTE G1.Assassin2

The first X79 board to hit the Labs; is it worth the asking price?

Street Price \$465 Supplier GIGABYTE

Website <http://www.gigabyte.com.au/>

Specifications LGA 2011; X79 chipset; E-ATX form factor; 3 x PCI-e x16 (2 x 16x, 1 x 8x electrically); 2 x PCI-e 1x; 1 x PCI; 4 x SATA2, 4 x SATA3, 2 x eSATA3; DDR3-2133

Nine months after the release of the original G1.Assassin, the G1.Assassin2 has emerged from the depths of GIGABYTE's labs to entice enthusiasts with a brand-spanking new socket and chipset pair. The Intel LGA 2011 socket and X79 chipset, otherwise known as the next generation platform for ridiculously expensive processors, is finally taking over the aging X58 chipset found on the original G1.Assassin after 3 years of loyal service.

The target audience that the G1.Assassin2 serves is much the same as its predecessor – high-powered workstations (whether that be gaming or video editing). The main features over Nehalem and X58 are a quad channel memory controller, 40 PCI-e lanes (compared to 36 lanes on X58), SATA3.0 support for two of the six available native SATA ports, and the very likely future support for PCI-e 3.0, judging by the use of PCI-e 3.0 standards compliant slots on this and other available X79 based motherboards.

3-way SLI and CrossfireX are also supported, where two cards are assigned 16x/16x lanes, while three get 16x/16x/8x. This is the main advantage of X79 over Z68, which relies on chipsets such as the NF200.

Surprisingly, there are no native USB 3.0 ports on the new chipset! We're not sure what's going on there, considering Intel had ample time to implement it. X79 and P67 share similar traits; it's the processors associated with each that are the key differentiators. Most functionality is now built directly onto the CPU, such as memory and PCI-e controllers.

A thin-finned block of metal serves as passive cooling for the toasty VRMs. Its small footprint allows for a pleasantly clean layout. The only other heatsink is on the PCH, and is shaped like

a handgun, not unlike the original G1.Assassin and its clip-inspired heatsink.

Despite the similar aesthetics between the two Assassin boards, the similarities aren't all skin deep. The Bigfoot Killer E2100 network processor is back, along with the onboard Creative CA20K2 sound solution.

GIGABYTE have finally jumped onto the EFI GUI bandwagon with '3D BIOS'. After entering setup, you're met with a picture of the G1.Assassin2. Clicking on a component of the motherboard will bring up its associated BIOS settings. Pressing escape takes you to a fancier rendition of the traditional Award BIOS layout.

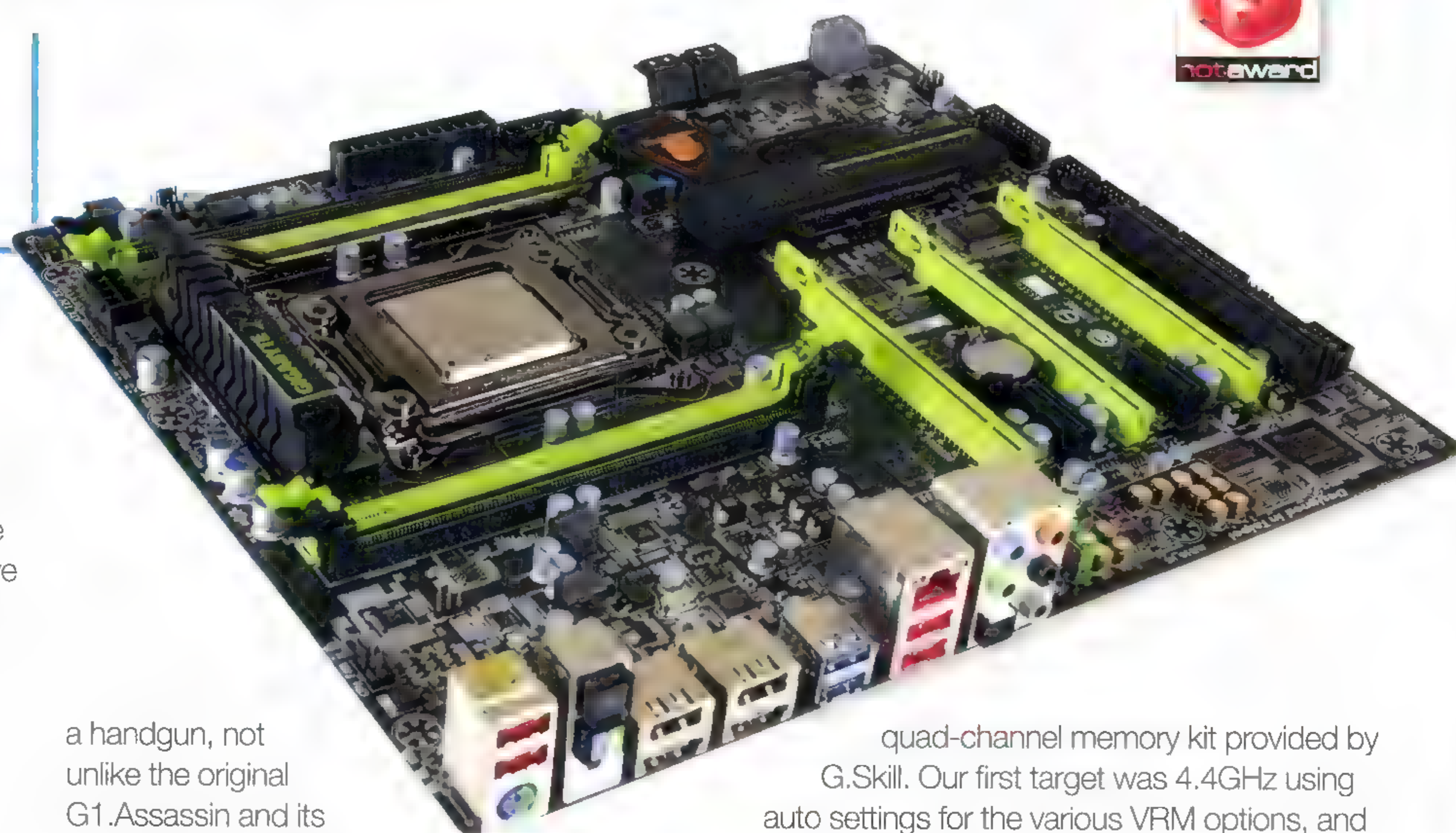
The back panel provides an OC button for a quick boost to 4GHz, in addition to a standard array of ports including a PS/2 port, 6 x USB 2.0, 2 x USB 3.0, 2 x eSATA/USB and a 1Gb/s RJ-45.

GIGABYTE have bundled plenty of additional extras, including a Wi-Fi (802.11n)/Bluetooth 4.0 card with dual antennas, a Crossfire and 3-way SLI bridge, a 3.5in 2x USB 3.0 front panel plate, and large stickers.

To test the overclocking capabilities of the board, we enlisted our newest initiate, the Intel Core i7 3960X, and a 2133MHz CL11-11-11-30

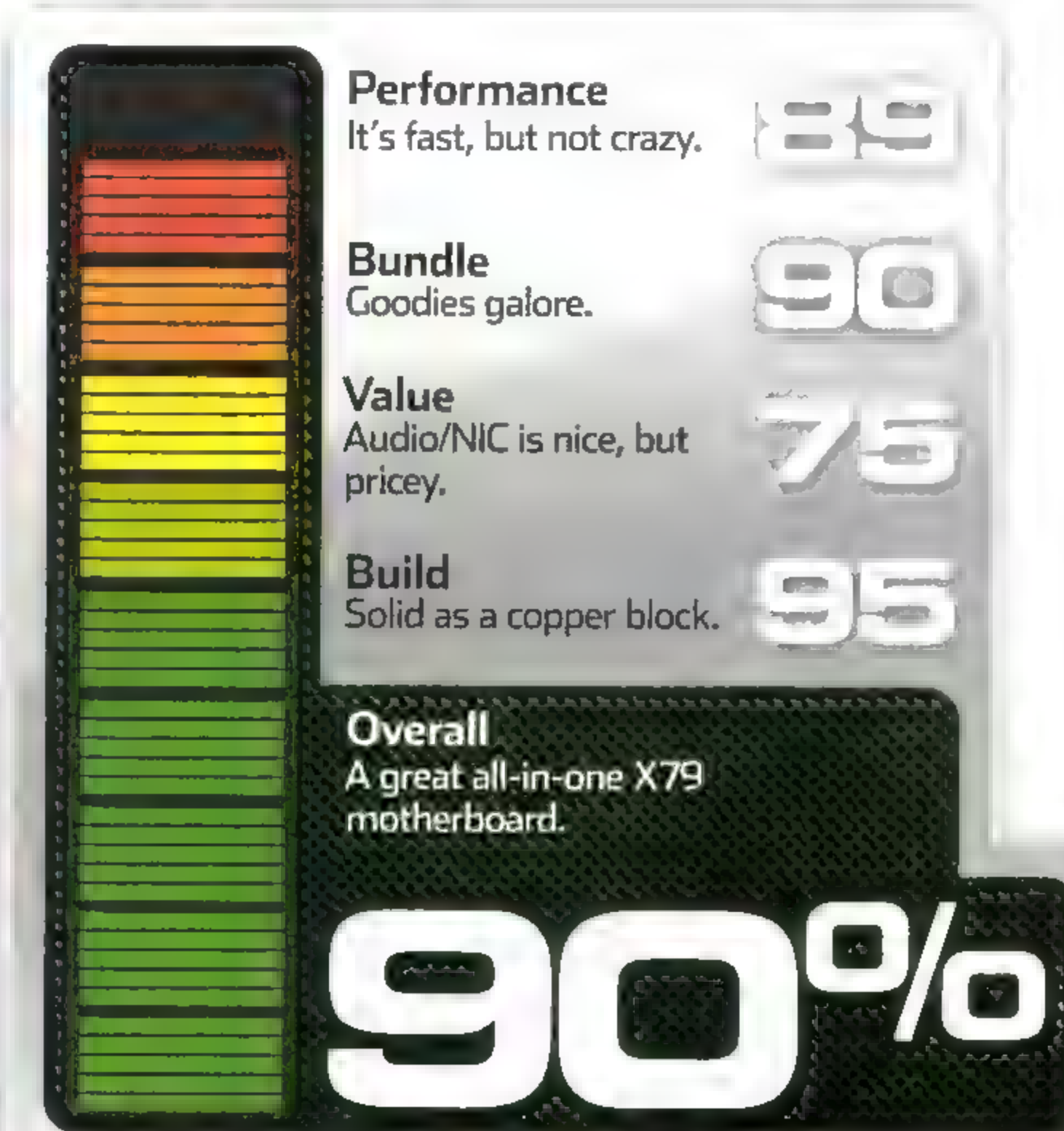
quad-channel memory kit provided by G.Skill. Our first target was 4.4GHz using auto settings for the various VRM options, and an excessive vCore of 1.5v. Both Prime95 and OCCT were happy with this, so we pushed further. Following a series of failed attempts at hitting 4.5GHz, we finally settled for 4.45GHz using a vcore of 1.525v. There was no way we were going to push it any further without risking damage to the processor. It's still early days with this CPU, so we're not certain of its absolute capabilities just yet, but we were a tad disappointed that we didn't quite reach a clock rate beyond 4.5GHz.

When it comes down to a recommendation, it's clear that this type of board is going to appeal to gamers with deep pockets. There's a lot of bang for your buck, provided you can justify the overall cost. A great sound solution paired with a platform capable of running multiple GPUs without breaking a sweat may be just what you need. All things considered, this is a definite step up from the original G1.Assassin in both design and performance. **VC**



GIGABYTE G1.Assassin2

| | Intel Core i7 3960X | 99 x 45; DDR3-2133 @ 10-11-10-24 | 99 x 45; DDR3-1600 @ 9-10-9-22 | 100 x 39; DDR3-2133 11-11-11-30 |
|---|---------------------|----------------------------------|--------------------------------|---------------------------------|
| PiFast | | 16.47s | 16.49s | 18.81s |
| wPrime 32M - single thread | | 31.465s | 31.451s | 35.926s |
| wPrime 32M - multi-thread (HT off) | | 6.716s (4.69x efficiency) | 6.77s (4.65) | 7.7s (4.67x) |
| CineBench R10 64bit - single thread | | 7414 | 7380 | 6474 |
| CineBench R10 64bit - multi-thread (HT off) | | 29838 (4.02x efficiency) | 31012 (4.2x) | 26875 (4.15x) |
| Everest Read | | 20657MB/s | 19894MB/s | 18727MB/s |
| Everest Write | | 17239MB/s | 17176MB/s | 15053MB/s |
| Everest Latency | | 52ns | 55.3ns | 55.6ns |





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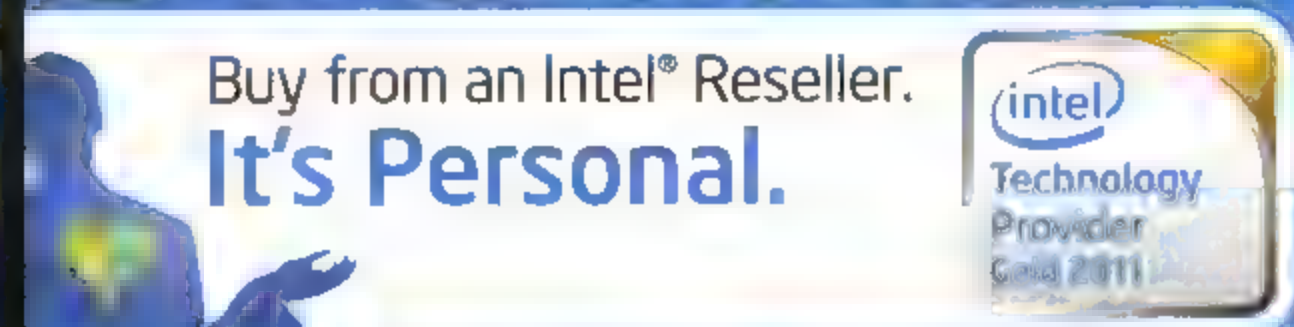
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CL9 Vengeance Memory for AMD, Intel® Dual Channel DDR3
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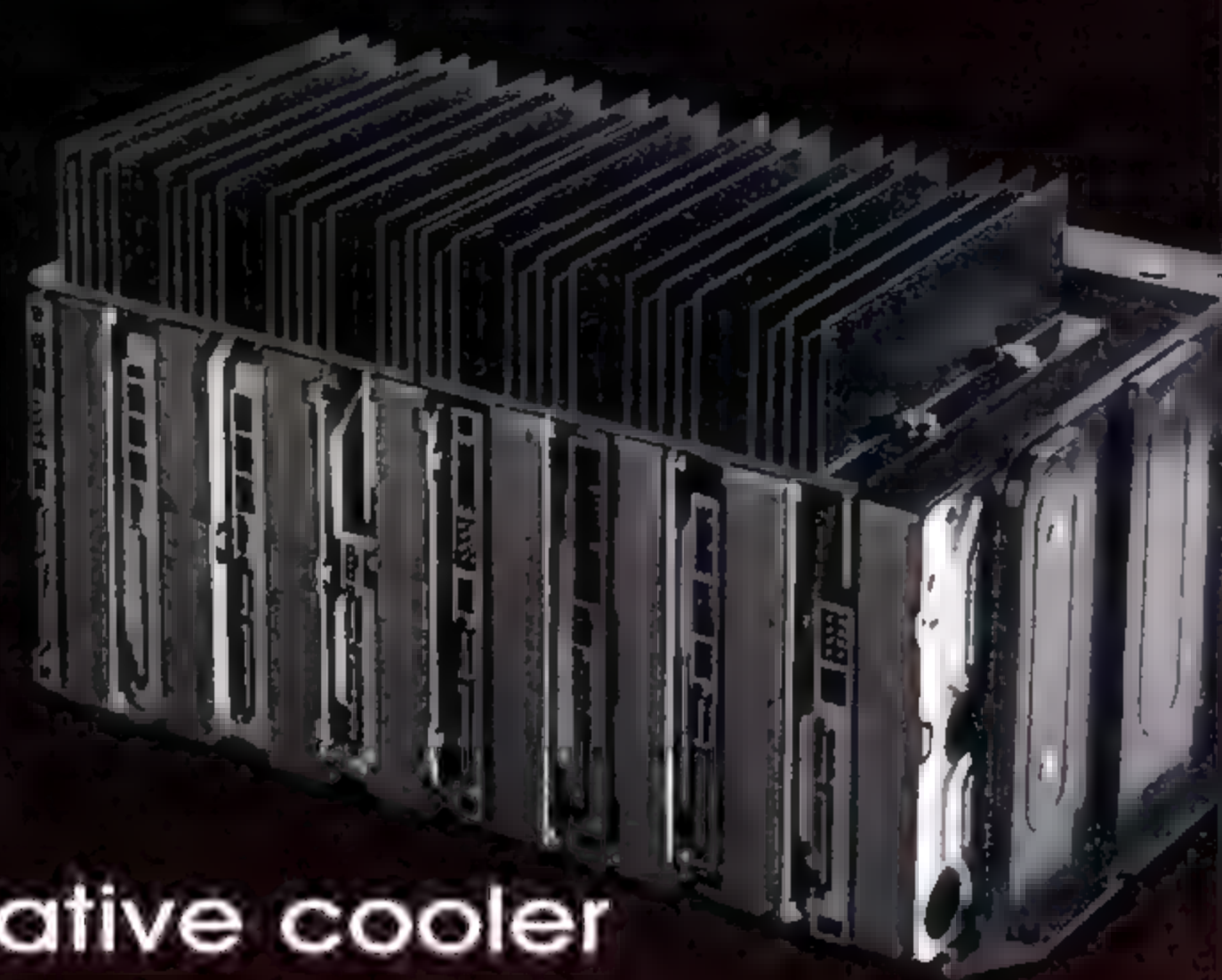
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ASUS MARS II GTX 580 SLI

NVIDIA, *this* is how you make a GTX 590.

Street Price \$1699 Supplier ASUS

Website <http://www.asus.com.au/>

Specifications 782MHz core; 1002MHz memory (4008MHz effective); GF110 cores; 2 x 512 unified shaders (CUDA cores); 3072MB GDDR5; 2 x 384-bit bus width; triple slot active cooling; triple 8-pin PCI-e power connections

Card info <http://www.techpowerup.com/gpuz/v43he>

9% OC



This card is overkill, in every way shape and form. It's heavy, it's bulky, it's amazingly sturdy, and it'll eat any benchmark for breakfast. If one were particularly violent, this card would become a very effective projectile given the sheer amount of metal used in the 33cm by 16cm brute.

Lengthy cards often come at the cost of build integrity, such that the PCB flexes due to lack of support. The MARS II GTX 580 SLI not only combats this issue, it far exceeds our expectations – this is one of the best cards we've tested in terms of physical sturdiness. It screams "drop test me", but given that this is one of 1000 limited edition cards ever made (just like their earlier attempt at limited editions, the Ares www.atomicmpc.com.au/?237340), and that impact resistance is completely irrelevant to the routine usage of a graphics card, we resisted the temptation... just. It's a far cry from the somewhat flimsy ASUS GTX 580 we tested in the May issue.

Underneath the alluring shroud lies two GF110 cores clocked at 782MHz, about 10Mhz higher than a stock GTX 580. This is surprising given that underclocking is one of the first things dual GPU cards are subjected to, to reduce heat output and power consumption. You'll need three 8-pin power connectors to bring this baby to life! Luckily ASUS includes two 6-pin to 8-pin adapters.

Maintaining what is naturally a fiery spirit requires a more than adequate cooling system. We're reintroduced to the ASUS DirectCU II cooling tech, made popular by other GTX 5xx

series cards in their product range. Essentially this means copper heatpipes running directly to, and contacting, each core directly.

Our testing revealed cool and quiet operation whilst idling, but once stressed, the card emits an extended war cry to remind you that yes, you're rendering your game with an awesome piece of very expensive kit. This is to be expected – there's even a button on the card to force constant 100% fan speed if you feel that it is required.

After about two seconds of admiring the stock clock rate of the GTX 580 SLI, we concluded that we could do better. We tried 850MHz on each GPU, setting 1.1v on the first, and 1.063v on the second (ASUS GPU Tweak didn't give us the option of 1.1v). FurMark and OCCT confirmed

that this was stable, and didn't appear to trigger any sneaky GPU throttling, which was nice. Eventually we reached 900MHz stable,

at which point we suspected that the clock rate wasn't being set properly. We proved that it was actually being overclocked by pushing it further, and causing FurMark to crash the system. And that was the end of our fun, because upon rebooting, the maximum stable overclock fell way back to 850MHz again. Whilst this sounds terrible, it's actually quite decent for a card of this nature. We're certain 900MHz+ is achievable with a good sample though.

It goes without saying that this card is the most powerful single card on the market. Given that the GTX590 is essentially two underclocked GTX580's sandwiched together, there's no doubt that two GTX580's are going to murder. Comparing it to ASUS's very own GTX 590 (reviewed in May), there's a clear lead set by the GTX 580 SLI, especially in Lost Planet 2 (12FPS difference), Unigine Heaven (13FPS difference with normal tessellation) and 3DMark 11 (X3348 vs X4417).

Buying one of these cards is not for the fainthearted. With only 1000 of these units up for grabs only the most hardcore need apply. **VC**

ASUS MARS II GTX 580 SLI



ASUS MARS II GTX 580 SLI Synthetic Benchmarks

Unigine Heaven, FPS Tess - 65.6
Unigine Heaven, FPS None - 103.8
3DMark 11 - X4417

ASUS MARS II GTX 580 SLI Gaming Benchmarks

Min - 43.48

Avg - 123.6

= Reference scores: XFX 5850

Frames per second

Performance
Can't touch this.

100

Bundle
Laser etched plate, standard adapters.

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65

Build
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95

Overall
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95%

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- Dim.: 230 x 512 x 489 mm
- Colour: silver / black

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PC-Q25B

- M/B type: Mini ITX
- Bays: 3.5" internal x 7 (Hot swap x 5), 2.5" internal x 3 (use 3.5" x 2)
- Dim.: 199 x 280 x 366 mm
- Colour: silver / black

ADVENTURER



PC-TU200A

- M/B type: Mini DTX, Mini ITX
- Bays: 5.25" x 1, 3.5" x 4 (Hot swap), 2.5" x 2 (use 3.5" x 1)
- Dim.: 220 x 320 x 360 mm
- Colour: silver / black

PC-X2000

****A WINDOW TO THE SOUL****

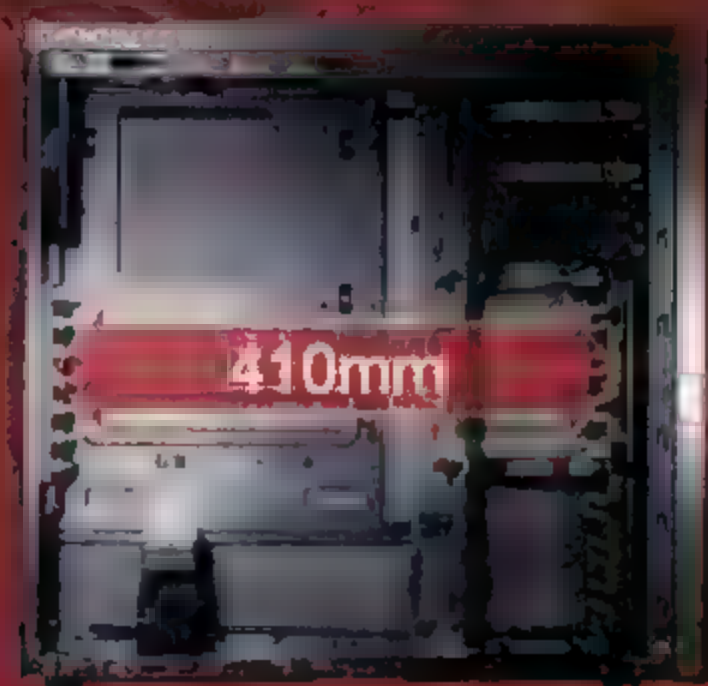
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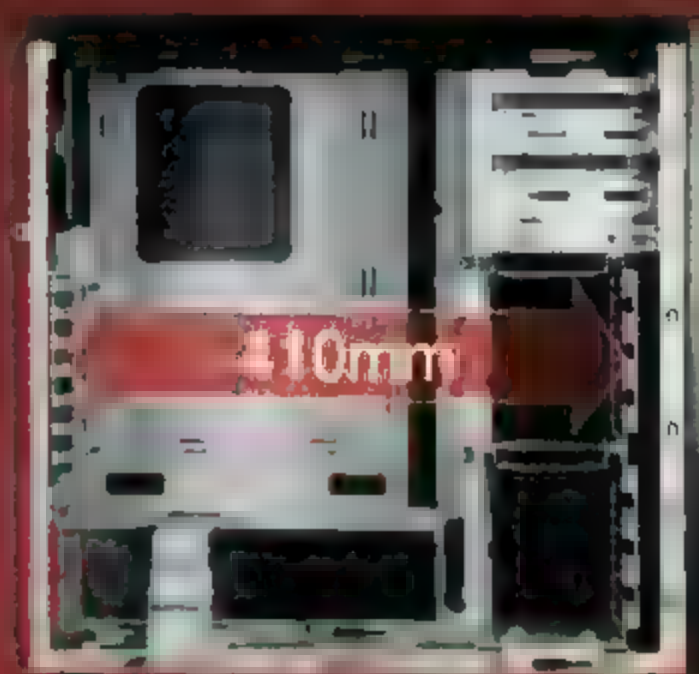


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PC-K9 WX

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- Supports long graphics cards.

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SilverStone Temjin TJ08-E

A small-but-mighty case for all walks of life.

Street Price \$109 Supplier SilverStone
Website <http://tinyurl.com/TJ08-E>

Specifications 210mm x 374mm x 385mm (W x H x D); 5.3kg; 1x 180mm fan (front), 1x 120mm fan mount (rear); 2x 5.25in drive bays, 1x 3.5in external bay, 4x 3.5in drive bays, 1x 2.5in bay; 4x expansion slots; steel body, aluminium front; mATX, ITX support.

Gallery www.atomicmpc.com.au/?278833

We've waxed lyrical about SilverStone's penchant for flipping traditional case designs around with wanton abandon before, but never fear, the company's continuing to give us fuel for that fire with yet another non-standard design that's making waves in the Micro ATX space. Called the TJ08-E, as an 'Evolution' of the earlier full-tower design, this case takes the traditional mATX layout and flips it 180 degrees – resulting in the CPU and heatsink sitting at the bottom of the case, graphics cards at the top.

Of course this design change isn't immediately apparent from the outside, as the nicely brushed aluminium fascia appears to be quite standard – though aesthetically pleasing. Hard angles abound with easy access to two USB 3.0 ports, whether the case sits on a desk or on the floor, and the power/reset buttons are similarly accessible. They feel a bit loose, but are easy to press (and honestly aren't used often anyway, with Sleep mode in W7 working so darn well).

The left-hand side of the case is bare painted steel, which is only noteworthy for granting access to the rear of the motherboard tray; there's ample room to run as many power or data cables as your heart desires. The right-hand side is where the action is, and removing the metal thumbscrews (which include little plastic washers to limit the scratching – a nice touch) reveals a rather spacious internal design.

Clearly intended to be cooled by the single

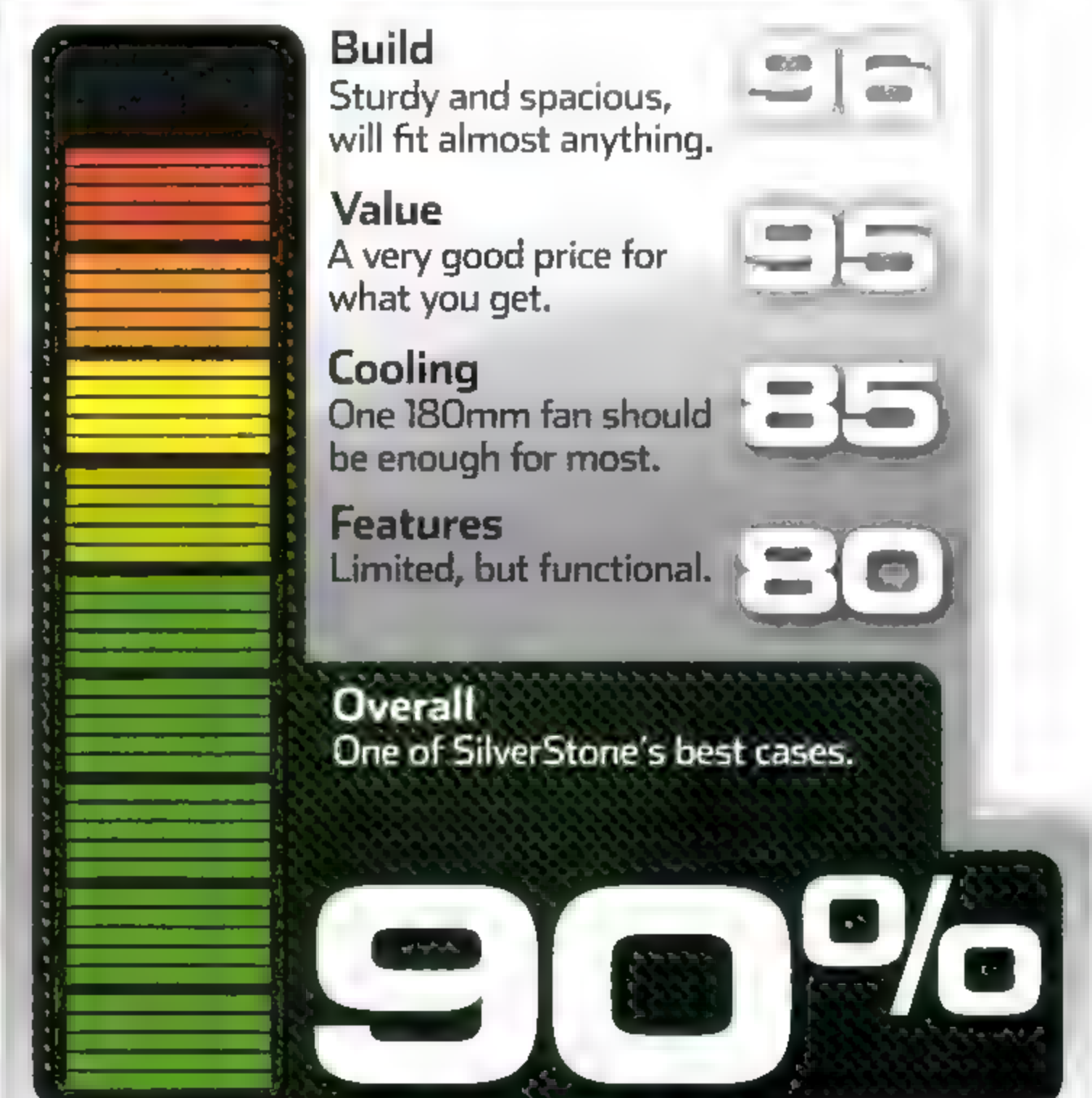
180mm intake fan, which also features an easily-removable filter, this inner chamber is partly separated from the 5.25in drive bays by a contiguous piece of steel. However, this choice ultimately appears aesthetic, with the real separation coming from power supplies with 120/140mm fans – there's a 120mm grille at the top (with filter) to allow for fresh, cool air to pass through the PSU without influence from the hot system. It's worth noting that although SilverStone suggests a length of 160mm for power supplies, up to 180mm will fit without too much trouble, leaving wiggle room for very powerful units (as seen in the gallery of pictures, linked above). Due to the tight nature of this case, six screws hold the top panel of the case on, with the PSU dropping in vertically.

Installing the motherboard into this case is simple enough, requiring that the HDD cage be taken out by removing two standard screws and sliding it out on two metal rails. This also facilitates installation of up to four storage drives into the cage, which comes factory-installed with sound and vibration-dampening foam to cut down on noise. Annoyingly there's no tool-less options at all in this case, though that's not entirely unsurprising considering its \$109 price.

Once the motherboard is in and secured with the included stand-offs, the heatsink

can be installed using the large cutout in the motherboard tray – though of course it's easier to do this outside of the case. The TJ08-E takes heatsinks up to 165mm in height (meaning the CoolerMaster Hyper 212 Plus at 159mm should fit fine), and includes a small plastic platform to hold the heatsink stable.

Though not packed to the brim with features, the build quality of this case is very good, and we were surprised at how well thought-out it was – it can even fit graphics cards up to 13.25in long (a HD 6990 is 12in), making this an option for high-powered mATX gaming systems. As such, the TJ08-E is worthy of a Hot Award; it'll suit all tastes and budgets. **JR**



Budget Number CRUNCHERS

Antony Leather and Paul Goodhead shuffle around ones and zeroes for your reading pleasure.

While most of us would love to build a PC around a dual-socket 8-core CPU system, this isn't always financially possible or even necessary, especially if you don't play games or use demanding programs. Few games take advantage of processors with more than four cores, and you don't need a \$1000 CPU to check Facebook and use Microsoft Office.

That's why we've rounded up some of the cheapest desktop processors we could find and pitted them against each other to see which offers the best performance in everyday applications. Some have on-board GPUs too, so we've also tested their performance in games, both with and without a graphics card, to determine whether or not you need to buy a graphics card at all for a modest gaming PC. By modest we mean "Farmville Champ 2011", but you get the idea.

As budget CPUs at the lower end of the market have a history of being overclocking monsters (seasoned overclockers may remember the legendary AMD Opteron 144), we've tweaked any overclockable CPUs and included these results to see how much more performance you could get for your dosh. Whether you're planning a budget build or a cheap workhorse and you need maximum performance for minimum outlay, these pages are invaluable reading.



How we tested

A processor sits at the heart of your PC and is the powerhouse behind most everyday tasks, such as web browsing, as well as more demanding jobs such as video and photo editing. It can also affect how well your PC can run games. As such, we generally throw all manner of work at the CPUs we test, but this month we've cranked it up a notch.

The advent of CPUs with integrated graphics, which AMD refers to as APUs (at least for its own processors), has meant that we've had to change our testing methods slightly in some areas. As we wanted to test the on-board graphics of processors that have them, there's a set of test results that were generated when we used a discrete graphics card, and another set for when we used the on-board graphics unit. This allows us to ascertain the difference in performance of a processor's integrated graphics to an external card. Our curiosity was fuelled by the fact that the GPU and CPU areas share the processor's cache. We also tested whether the integrated graphics were fast enough to run 3D games at decent settings and resolutions.

As we're testing the on-board graphics of budget processors, we've toned down our game tests to better represent the kind of settings these CPUs would face in the wild. After all, if you want to play the latest games at maximum settings at 1920 x 1080, there's no avoiding the

fact that you'll need to invest in a fast discrete graphics card.

We used Battlefield: Bad Company 2 and Arma II: Operation Arrowhead for our game tests, at 1280 x 720 and 1920 x 1080. We opted for high detail settings in each game, rather than maximum, and we disabled AA. This meant that the visuals lost a little wow factor, but were still a challenge for the on-board graphics on test. Using the 64-bit version of Windows 7 Home Premium, we also ran our usual suites of CPU tests, which includes our Media Benchmarks, Cinebench 11.5 and wPrime's 32M test; we also measured the idle and load power draw.

Our test kit included three motherboards to cater for the three different processor sockets on test: for FM1 processors, we used an MSI A75MA-G55; for Socket AM3+, we used an ASUS M5A88-M; and for LGA1155, we used an ASUS P8H61. We also used 4GB of Kingston 1866MHz HyperX memory and a 2TB Western Digital Caviar Black hard disk, adding a Radeon HD 6850 1GB for tests involving a discrete graphics card.

Only AMD's CPUs in this test were overclockable, with the overclocked performance adding to their overall score. As all of the Intel CPUs lacked the 'K' suffix from their model names (denoting that their CPU

multipliers are locked) their score is based solely on stock-speed performance.

The speed of each processor is derived from the results with the discrete graphics card installed, as some processors don't have on-board GPUs, so these were the only directly comparable results. The speed and capabilities of integrated graphics units did contribute toward a processor's score.

The TDP of each CPU is important when you consider that many of the CPUs we've included this month would make ideal partners for small, low-power PCs. With electricity prices rising, power draw should be on your list of concerns too, especially if you plan to use the CPU in a PC that will be switched on for extended periods, such as a home server or media PC.

The ability to overclock a CPU is always welcome, but even more so at the budget end of the spectrum. As such, CPUs were also awarded points if they included unlocked multipliers.


Value is one of the most important factors when choosing a CPU, but we insist that value means what you get for your cash, and not merely cost. While some CPUs are available for less than \$50, they often represent a false economy where spending just a little more can pay huge dividends. All these factors are included in the Overall score of each chip.




AMD A6-3650

Novel, but somewhat underwhelming.



 Competent on-board GPU.

 A8-3850 only \$20 more; poor in 2D tasks; not particularly power efficient.

Street Price \$130

Website <http://tinyurl.com/AMDAPU>

Specifications 4 x 'Husky' CPU cores @ 2.6GHz; 320 'Evergreen' Radeon cores @ 443MHz; 128KB L1/core; 1MB L2/core; 100W TDP; integrated Northbridge; DDR3-1333 dual channel memory controller; DX11, UVD3; Turbo Core 2; 32nm HKMG process; Socket FM1

AMD's new FM1 processors hit the market with a bang; it was finally possible to play games on a reasonable-sized monitor using integrated graphics. This was exciting both for enthusiasts and system integrators, as it opened up the possibility of making tiny-yet-capable gaming machines.

Much of the goodwill and excitement surrounding the A-series APUs was generated by the performance results of the flagship A8 processors, though, so we wanted to find out how one of the cheaper – and obviously slower A6 processors – would fare.

The key difference between the A8 and the A6 range is the potency of the on-board GPU. The Radeon HD 6530D that sits on the die of the A6-3650 sports only four SIMD engines, rather than the five found in A8 APUs, which means that the GPU has a total of 320 stream processors and 16 texture units. The HD 6530D also has a lower clock speed than the

HD 6550D of A8 processors, at 443MHz rather than 600MHz.

The CPU portion of the APU is functionally identical to that of AMD's A8 processors (four cores and 4MB L2 cache), but it runs at a reduced 2.6GHz clock speed. Intriguingly, the A6-3650 has the same 100W TDP as the A8-3850, despite having a lesser GPU and a lower CPU clock speed. This is likely due to the lower binning of the part.

The APU's four physical cores helped it to perform well in Cinebench 11.5, as it scored the third-highest stock-speed score of 3.08. The \$130 processor fared less well in our Media Benchmarks, however, scoring a particularly poor 856 points in our image editing test and an overall score of 1,008. This placed it very close to the bottom of the table.

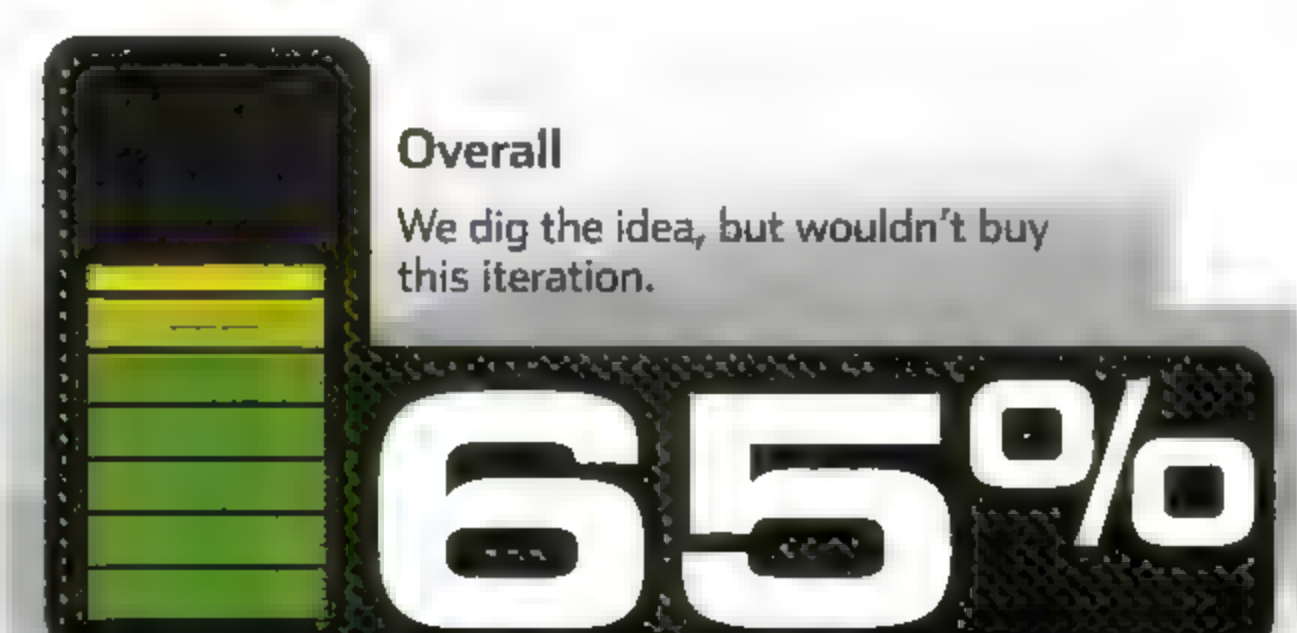
The A6-3650 also failed to provide playable frame rates in any of our test games, although it's worth pointing out that we were running both games at high settings (albeit with no AA), and that dropping these settings would probably result in playable frame rates. Performance with a discrete GPU installed in the system proved to be good in Bad Company 2, but poorer than

cheaper, higher-frequency processors such as the Phenom II X2 560 BE in Arma II.

Overclocking an A-series APU is tricky, but we were able to push the A6-3650 to 3GHz using a Reference Clock of 115MHz and its default CPU multiplier of 26x. This required a vcore of 1.542V and a CPU/NB of 1.23V.

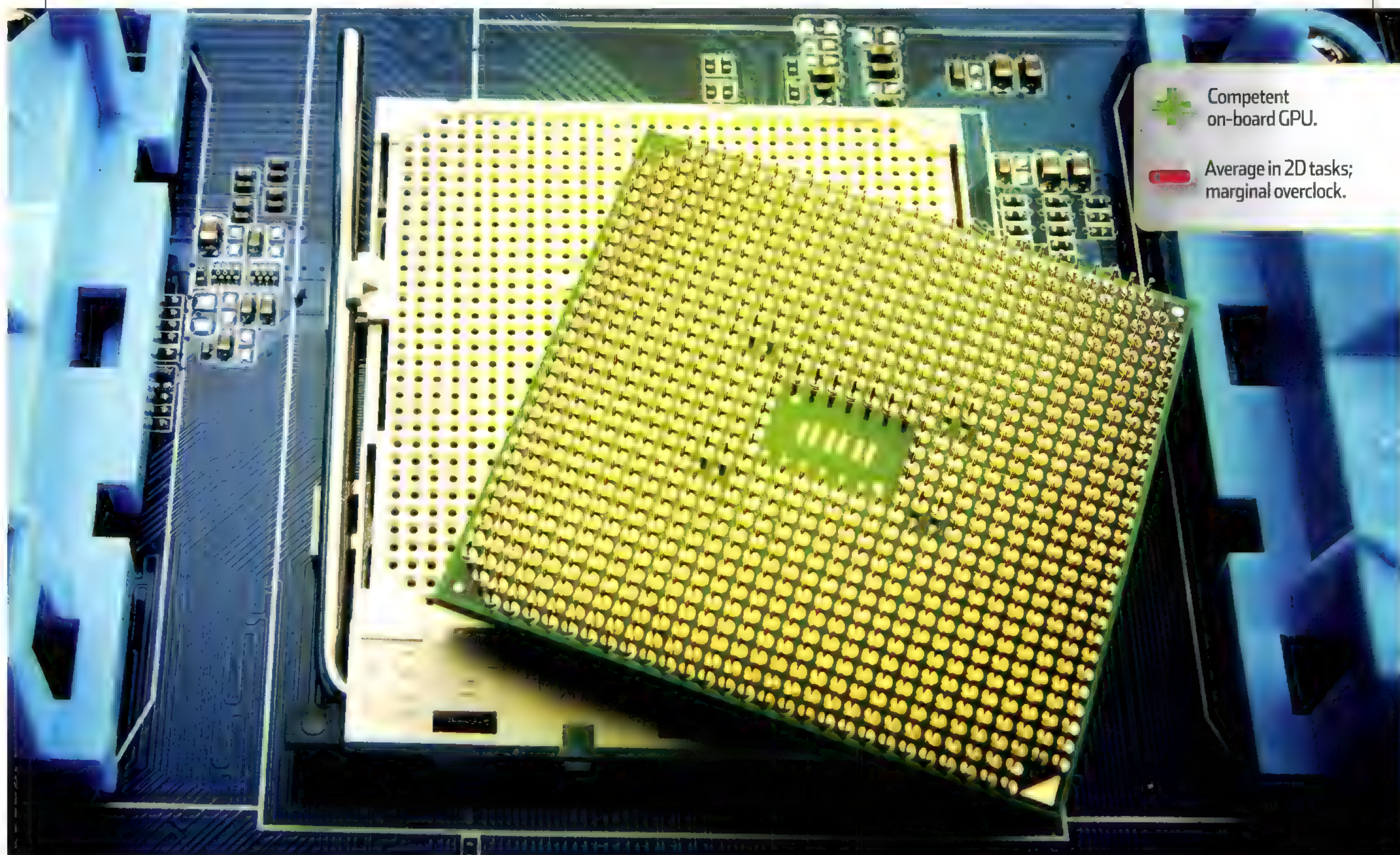
We saw an appreciable performance bump at these speeds; results in our Media Benchmarks increased by 169 points to 1,177, and we saw an improvement of 2-5fps in our game testing too, both with and without a discrete GPU.


However, the more powerful A8-3850 costs only \$20 more, which gains speed across all parts of the chip, and is a much better buy.




AMD A8-3850

Significantly improved on the lower-end model.



 Competent on-board GPU.

 Average in 2D tasks; marginal overclock.

Street Price \$150

Website <http://tinyurl.com/AMDAPU>

Specifications 4 x 'Husky' CPU cores @ 2.9GHz; 400 'Evergreen' Radeon cores @ 600MHz; 128KB L1/core, 1MB L2/core; 100W TDP; integrated Northbridge; DDR3-1333 dual channel memory controller; DX11, UVD3; Turbo Core 2; 32nm HKMG process; Socket FM1

We saw the AMD A8-3850 for the first time in September (see www.atomicmpc.com.au/?272095) and were impressed by it; it's the first time we've ever been able to game comfortably at 1920 x 1080 with all the settings on high (apart from AA) when using an integrated GPU. We're testing the A8-3850 again, however – this time in context with other processors and different tests – to find out if it still retains its charms.

Physically there's little to differentiate the A8-3850 from the cheaper A6-3650; both are FM1 APUs based around a quad-core CPU design. The four cores of the APU are based on the Husky design, which is little more than a slight tweak and process shrink of the K10 Stars microarchitecture – the basis of AMD's mobile Phenom II processors. Most notably, AMD has removed the L3 cache from the design (presumably to accommodate the GPU), so while each core has a 128KB pool of

L1 and a 1MB pool of L2 cache, there's no larger pool of shared cache on which to draw.

The A8-3850 performed well in Cinebench 11.5 and wPrime; only the 3.2GHz Phenom II X4 955 BE could beat it in these tests. The A8-3850's performance wasn't as impressive in our Media Benchmarks, though, which look at both memory performance and instructions per clock. The A8-3850 scored an overall 1,113, which is a mid-table result and slower than cheaper processors such as the dual-core Pentiums.

The A8-3850 performed admirably in games when using its on-board GPU. Arma II was playable at 1280 x 720 with everything set to high, and while Bad Company 2 was just below playable on the same settings, lowering a couple of options would improve matters. The A8-3850 also performed well with our discrete GPU installed in the system – it outperformed the two Core i3s in both games at 1920 x 1080.

As with the A6-3650, you can overclock the A8-3850. However, FM1 overclocking is limited by the motherboard, and how the clock dividers for the SATA and USB buses are divided. Thankfully, the MSI A75MA-G55 we used for testing uncouples the SATA and USB

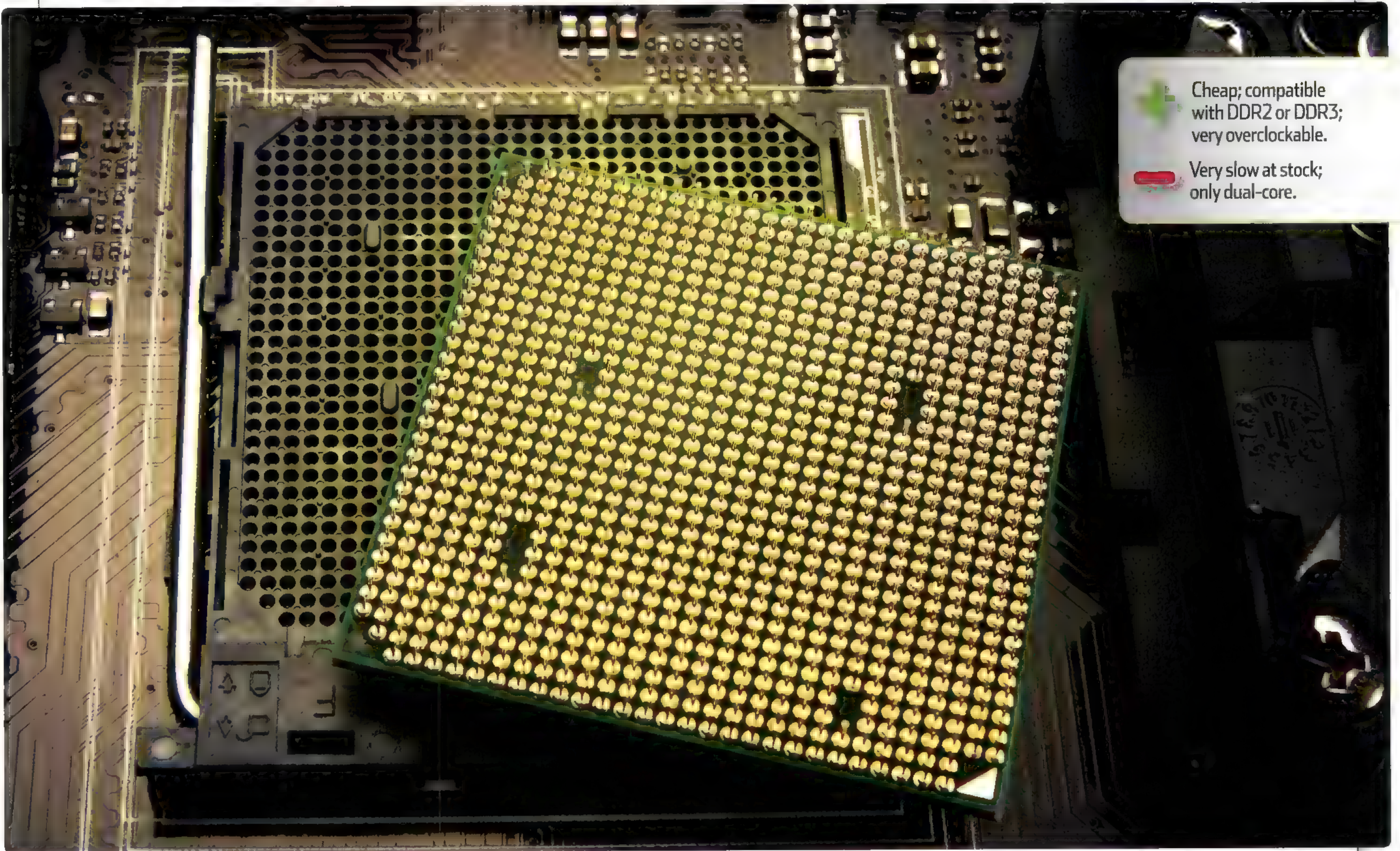
buses, so we could adjust the Reference Clock without issue. We eventually settled on a 3.33GHz overclock using a 115MHz Reference Clock, while also boosting the GPU from 600MHz to 700MHz.


This allowed the A8-3850 to overtake the Pentium G620 and Pentium G840 in our Media Benchmarks, although it lagged behind the similarly priced Core i3 processors. We didn't see much increase in frame rates from the on-board GPU, however. For media PCs and low-cost gaming rigs, the A8-3850 is great, as it's the only CPU that can play demanding games smoothly without additional hardware. It's also quite fast with an external GPU, making it a solid budget option.

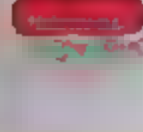


AMD Athlon II X2 250

Regor round two!



 Cheap; compatible with DDR2 or DDR3; very overclockable.

 Very slow at stock; only dual-core.

Street Price \$85

Website <http://tinyurl.com/AMDX2-250>

Specifications 2 x 'Regor' CPU cores @ 3GHz; 128KB L1/core; 1MB L2/core; 65W TDP; DDR3-1333 dual channel memory controller; 45nm SOI process; Socket AM3

The AMD Athlon name is looking very long in the tooth – we saw our first Athlon CPU over a decade ago. The range has seen its fair share of successes and failures, and made its name when facing off against Intel's NetBurst-based Pentium 4 CPUs, typically besting it in every category.

AMD now uses the Athlon name to denote low-end CPUs such as the Athlon II X2 250 which, at just \$85, is the third-cheapest processor in this Head2Head. We've already seen this chip in September of 2009 (online at www.atomicmpc.com.au/?155263), and it has not aged well.

Under the heatspreader of the X2 250 is a pair of Regor cores, each of which has a 128KB pool of L1 cache. This is complemented by a larger 2MB pool of shared L2 cache, although the processor lacks the L3 cache of its more expensive Phenom II siblings.

The two cores of the X2 250 run at a not-insignificant 3GHz, which is achieved by using

an HTT of 200MHz and a CPU multiplier of 15x, while the on-board memory controller can deal with memory speeds of up to 1333MHz. AMD rates the processor as having a TDP of 65W, which is average for a modern dual-core CPU.

We didn't expect the X2 250 to set any performance records, so we weren't surprised to see it score a measly 1.73 points in Cinebench 11.5, beating only the woefully underpowered AMD Sempron. Interestingly, the X2 250 performed better than the cheaper Pentium G620 in wPrime, but scored only 921 points overall in our Media Benchmarks suite – the second-worst stock-speed result.

The X2 250 doesn't include an on-board GPU, so we could only test the CPU's gaming performance with the discrete HD 6850 1GB we used for this Labs test. Unfortunately, the X2 250's lack of grunt was incredibly apparent; its results were poorer than those we saw from the Pentium G620.

The silver lining for the X2 250 is that it can be overclocked. Even pushing the processor to a hefty 4.2GHz – using a vcore of 1.55V, a CPU/NB voltage of 1.275V and an HT voltage of 1.3V – only moved the CPU to a mid-table spot in our Media Benchmarks. This was

enough to leapfrog the two cheapest Intel Pentium CPUs, but it failed to trouble either of the Core i3s, although these cost almost twice as much as the X2 250.

Gaming performance also saw an appreciable boost when the CPU was overclocked, although the CPU suffered for having only two cores – most of the processors that performed better had four cores or two additional Hyper-Threaded cores.

The X2 250 is a disappointing CPU at stock speeds, but gets a decent boost if heavily overclocked. If you have only \$80 to spend on a CPU, the Pentium G620 guarantees a similar level of performance as a 4.2GHz X2 250, without the need to overclock or buy an expensive overclocking-friendly motherboard.

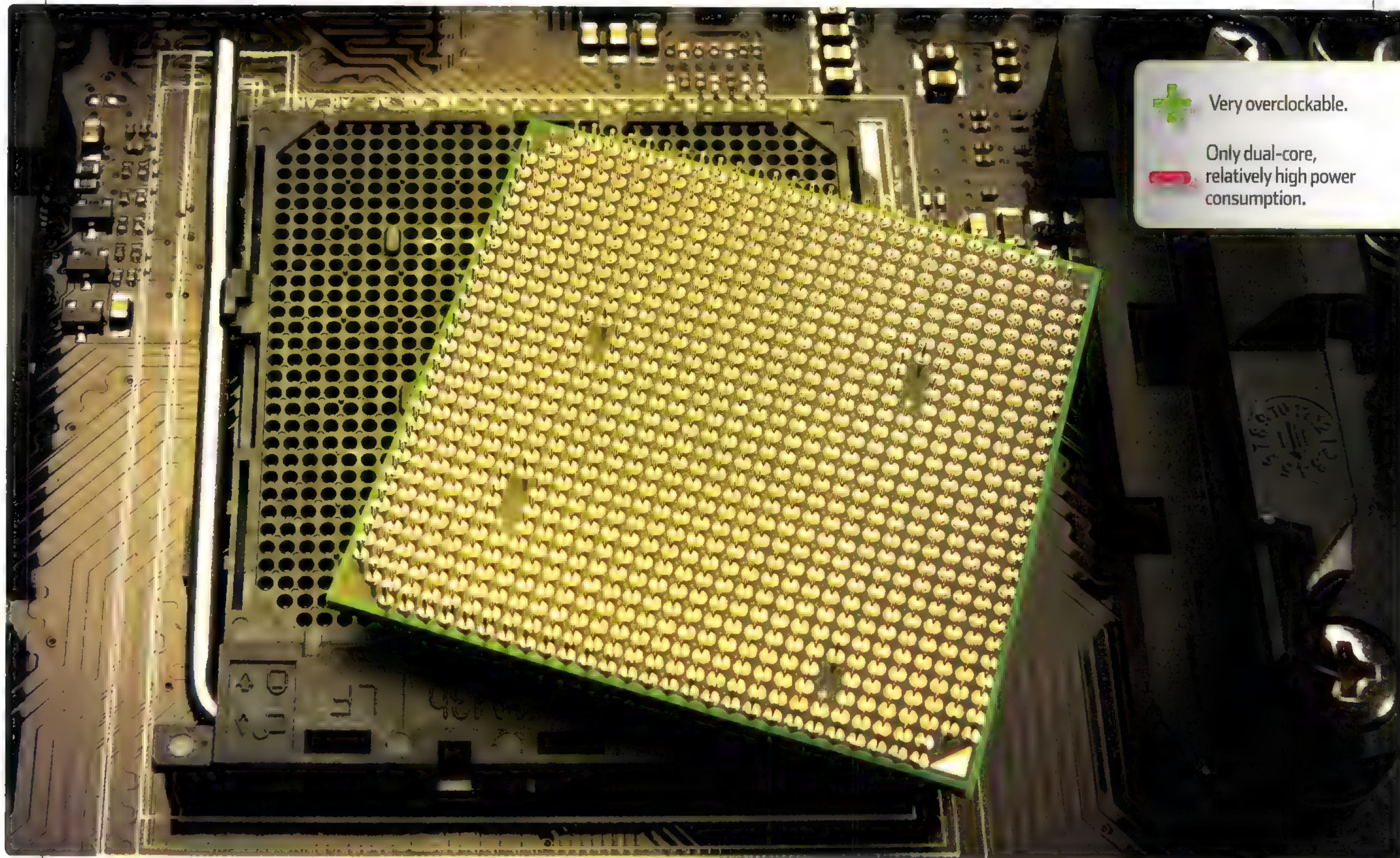
Overall


We're still not sure why you'd buy one.




AMD Phenom II X2 560 Black Edition

Be a member of the least exclusive club.



 Very overclockable.

 Only dual-core, relatively high power consumption.

Street Price \$120

Website <http://tinyurl.com/AMDX2-560>

Specifications 2 x 'Callisto' CPU cores @ 3.3GHz; 128KB L1/core, 512KB L2/core, 6MB L3 shared; 80W TDP; DDR3-1333 dual channel memory controller; 45nm SOI process; Socket AM3

CPUs that carry the Black Edition moniker used to be limited to the top-end models of each family. This is because processors with the Black Edition tag are blessed with an unlocked multiplier – an enthusiast-friendly feature that adds extra flexibility when overclocking. AMD has steadily increased the number of Black Edition processors, however, and you can now buy into the club with a Phenom II X2 560 Black Edition for \$120.

Learned readers will be able to discern that the X2 560 BE is a dual-core processor (as designated by the X2 part of its name), although they may not know that the two cores are based on the 45nm Callisto core, which was first introduced back in June 2009. As the processor is a Phenom II model, it sports three levels of cache – 128KB of L1 and 512KB of L2 per core, and a comparatively huge 6MB pool of shared L3.

The stock speed of the X2 560 BE is

3.3GHz, the highest on test. This means that the CPU has a TDP of 80W, however, which is relatively high for a dual-core CPU. The X2 560 BE supports memory speeds of up to 1333MHz and is compatible with DDR2 and DDR3.

The CPU's high clock speed didn't help much in Cinebench 11.5, as its stock-speed score of 1.95 was lower than those of Intel's cheaper and lower-clocked Pentium processors. The same was true in our Media Benchmarks, as its overall score of 1,054 was 99 points behind the Pentium G620 and even further behind more expensive Pentium processors.

Gaming proved to be only marginally more successful for the X2 560 BE; at stock speeds it was slower than quad-core processors such as the Phenom II X4 955 BE and the A8-3850. Clearly, our two test games enjoy having more than two cores.

Overclocking the X2 560 BE was a fairly simple task and we quickly found the processor's maximum stable overclock of 4.25GHz. This was achieved with an HTT of 305MHz, a CPU multiplier of 14x and a vcore and CPU/NB voltage of 1.565V and 1.275V respectively.

At these speeds, the X2 560 BE's

performance significantly increased, jumping 266 points in the Media Benchmarks. This placed it ahead of all the non-overclockable Pentium CPUs. Gaming also saw a decent boost, particularly in Arma II, which appears to love extra processor frequency. Overclocking the CPU had a dramatic affect on its power consumption, though; when overclocked and at full load, the system drew 290W from the wall with the X2 560 BE installed, which is the third-highest result we saw.

As a result, it's hard to recommend the Phenom II X2 560 BE unless you're willing to overclock it. The Pentium G850 is almost as fast, and doesn't require any tweaking for decent speeds.



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MASTER**

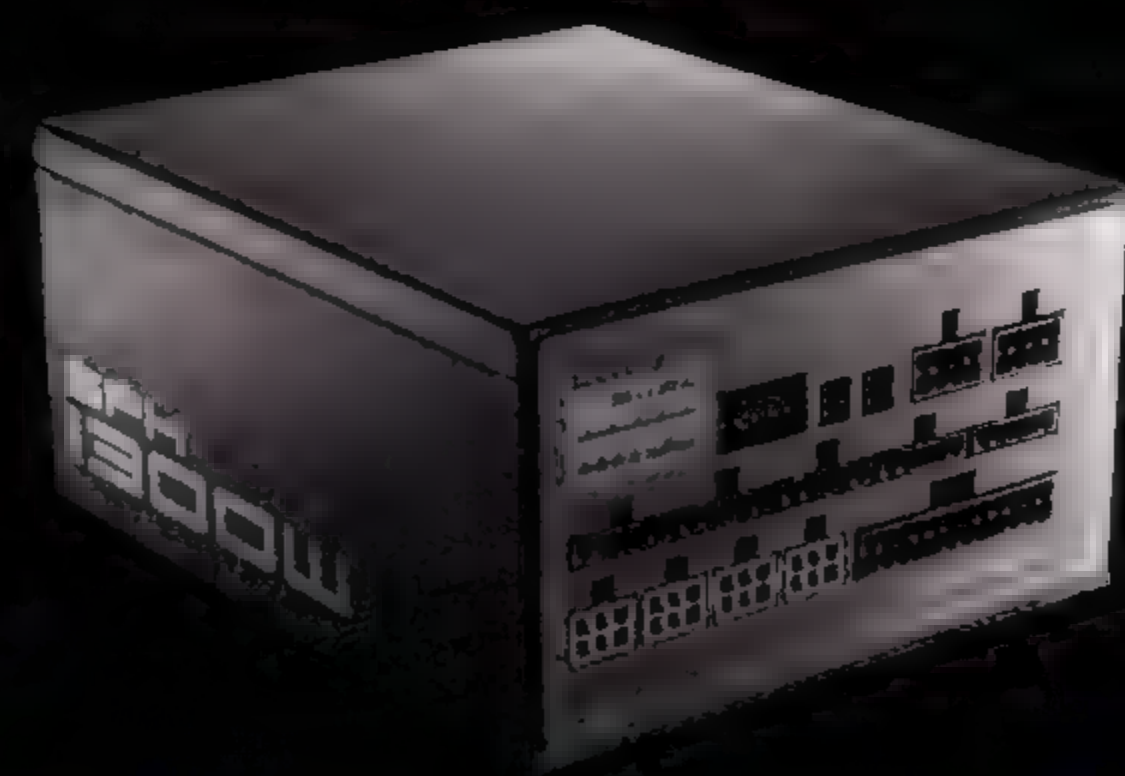
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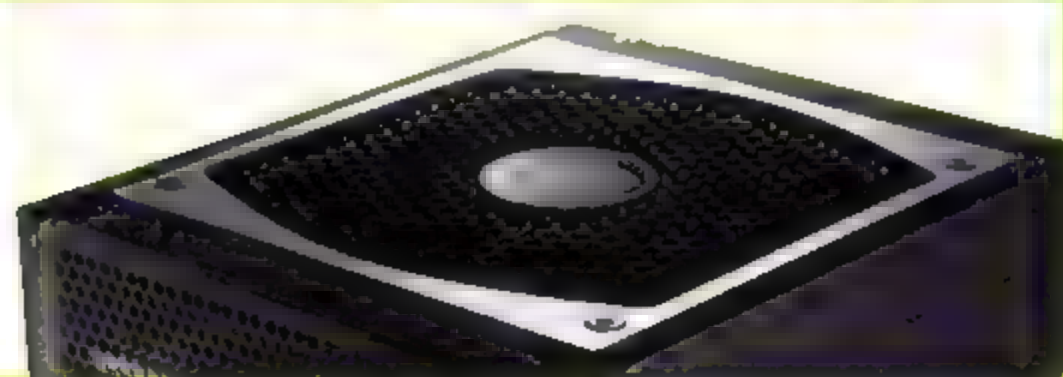
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5.25" control panel for 135mm PSU and three system fans

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Fanless operation with 135mm fan is at 0dB when loading is under 200W or 25°C

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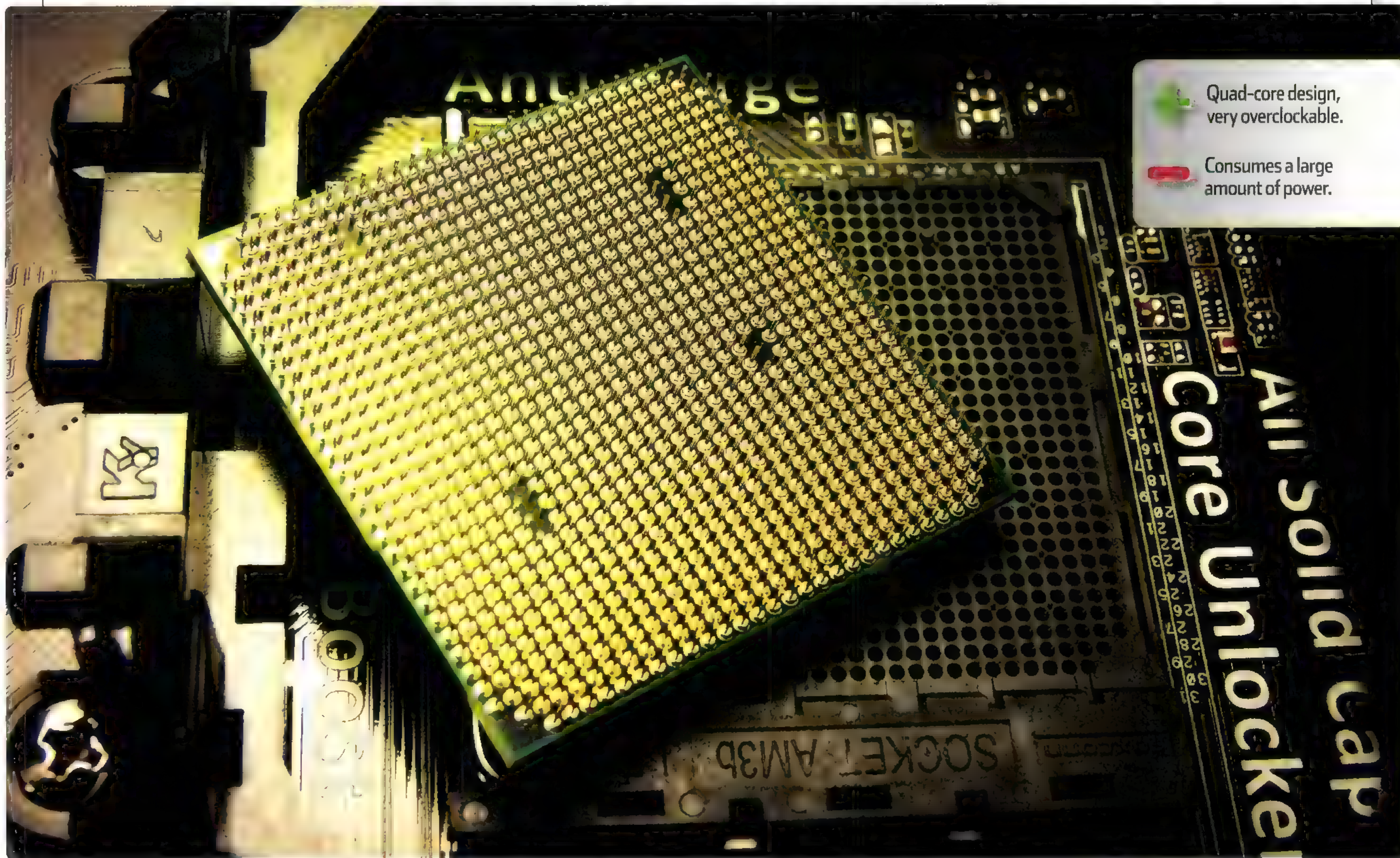
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AMD Phenom II X4 955 Black Edition

Four blisteringly hot cores in one package.



Quad-core design, very overclockable.

Consumes a large amount of power.

Street Price \$150

Website <http://tinyurl.com/Phen955>

Specifications 4 x 'Deneb' CPU cores @ 3.2GHz; 128KB L1/core, 512KB L2/core, 6MB L3 shared; 125W TDP; DDR3-1333 dual channel memory controller; 45nm SOI process; Socket AM3

At \$150, the Phenom II X4 955 Black Edition is one of the most expensive processors in this Head2Head, coming in at the same price as the A8-3850, but you get a lot for your money. The processor is one of only three that has four physical cores, and these are based on the full-fat Deneb design too, so each receives 128KB of L1 cache and 512KB of L2 cache, while sharing a larger 6MB pool of L3 cache.

Despite having four physical cores, the X4 955 BE runs at 3.2GHz – the second-highest frequency of the processors on test. This should mean the CPU performs well, but having four cores and a high clock speed also means a higher power draw; the X4 955 BE's TDP of 125W is the highest of the processors here. This means that it requires a more powerful cooler than the other processors, limiting its use in areas where noise, power consumption or size are restricting factors, such as in small form factor or media PCs.

As with the other K10-based AMD

processors, the X4 955 BE lacks an on-board GPU – if you don't want to buy a discrete GPU, the only option would be to buy a motherboard with on-board graphics. Not surprisingly, given its resources and price, this AMD quad-core CPU performed well in our Media Benchmarks suite; its score of 1,213 was the fourth-fastest stock-speed result, behind the slightly more expensive Core-i3s and the cheaper Pentium G850. However, in both Cinebench 11.5 and wPrime – both of which reward core count and frequency – the X4 955 BE was peerless, coming top in both tests.

Thanks to its high frequency and the fact that our two test games can take advantage of the extra cores on offer, the X4 955 BE was also competent at gaming. It was in the top four stock-speed results for every test, apart from the Arma II test at 1920 x 1080, where it mysteriously dropped down the rankings.

We expected the X4 955 BE to be a competent overclocker given that the Phenom II X4 980 BE, which is also based on the Deneb core design, sports a clock speed of 3.7GHz. We managed to push the X4 955 BE all the way

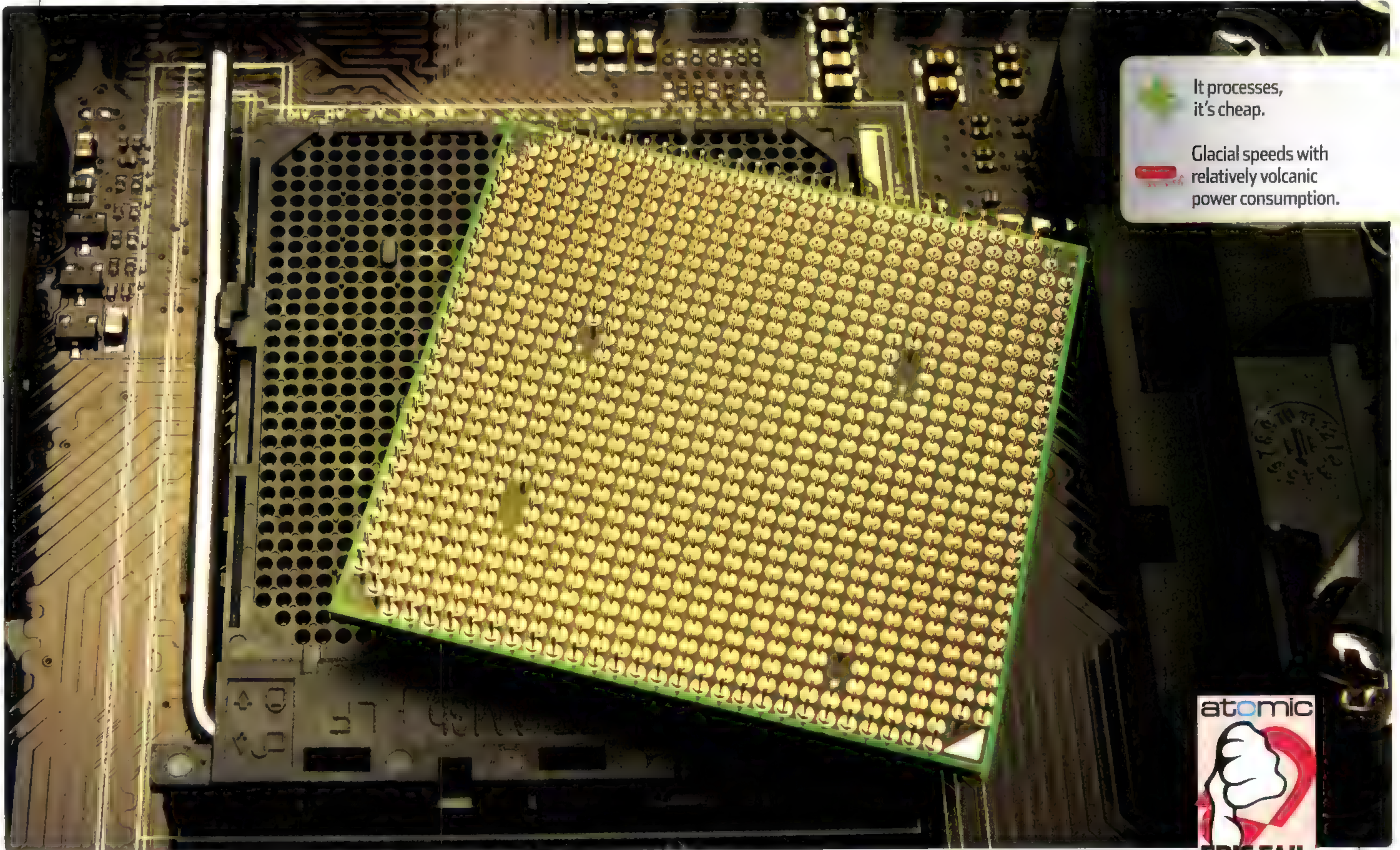
to 4.2GHz by using a vcore of 1.565V and a CPU/NB of 1.235V. At these settings, the X4 955 BE jumped to the top of our Media Benchmarks table with 1,605 points. This jump was accompanied by a significant bump in power consumption, however – our test system drew 400W from the wall under full load, twice as much as the Core i3-2100, despite the latter being only 7 per cent slower.

There's no doubt about the raw power of the X4 955 BE, but the Core-i3 2100 is nearly as fast for less power consumption. Its lack of an on-board GPU also makes it less flexible than the A8-3850. You'd have to think long and hard about choosing this chip.



AMD Sempron 145

Guaranteed to ruin your life, and the lives of those you know.



It processes,
it's cheap.

Glacial speeds with
relatively volcanic
power consumption.



Street Price \$42

Website <http://tinyurl.com/Sempr145>

Specifications 1x 'Sargas' CPU core @ 2.8GHz; 128KB L1/core; 1MB L2/core; 45W TDP; DDR3-1333 dual channel memory controller; 45nm SOI process; Socket AM3

At just \$42, the AMD Sempron 145 is by far and away the cheapest processor on the market. It boggles our minds a little that AMD can actually sell a full-size, current-socket processor for so little, given the production costs.

The Sempron 145 is a single-core CPU based on the Sargas design, which is the same Regor die that you'll find in the Athlon II X2 250, but with one of the two CPU cores disabled. As a result, the CPU has half the cache of the X2 250, with just 128KB L1 and 1MB L2 cache.

The processor runs at 2.8GHz and is rated by AMD as having a TDP of just 45W. This statistic makes the Sempron 145 seem like an attractive proposition for a low-power system, such as a car PC or a small media PC, but we'd advise holding off on planning that build until you've seen the horrendous performance figures.

Both wPrime and Cinebench 11.5 are

heavily multithreaded, and pushing them through the single core of the Sempron 145 was like blocking off three of the four lanes of a motorway – the result was basically a 20-mile traffic jam. The processor took ages to churn through both the benchmarks, scoring a laughable 0.8 points in Cinebench 11.5 and taking 56.504 seconds to run wPrime 32M.

These spectacularly poor results were followed by three of the slowest results we've ever seen in our Media Benchmark suite. The Sempron's overall score of 601 points was lower than every other processor we've tested in recent times, and highlights the false economy of buying such a cheap processor; the \$90 Pentium G840 scored twice as high and was significantly faster in everyday tasks.

The Sempron 145 didn't even compensate for its appalling performance with stellar power efficiency. At full load, the system drew 178W from the wall with the CPU installed. This was more than the Pentium and Core-i3 processors, despite the fact that these CPUs are more than twice as quick as the Sempron 145.

The processor's single core couldn't provide our discrete GPU with data quick enough either, meaning that the performance of the HD 6850

1GB graphics card we used for testing was hobbled. The minimum frame rate of 14fps we saw with the Sempron 145 in our test system in Bad Company 2 at 1920 x 1080 was 26fps slower than the 40fps minimum we saw with the Phenom II X4 955 BE installed in the same test system.

Thankfully, we could overclock the processor, pushing it all the way up to 3.9GHz using a vcore of 1.49V and a CPU/NB of 1.25V. Even at this clock speed, though, one core was still woefully inadequate.

Our time with the Sempron 145 was infuriating and demeaning. Unless you're some kind of CPU masochist, we'd suggest buying a CPU that won't make you feel like an abject failure at everything.



Other uses for on-board graphics

Antony Leather on harnessing the underused potential of your hardware.

Amazingly, even in two of today's most demanding games, the latest APUs from AMD can achieve playable frame rates if you aren't planning to run games at their maximum settings. This is great news, as it means that you could potentially save on a suitable discrete graphics card. We'll always recommend playing games at their maximum settings with a real graphics card where possible, but if money is tight, then the A6- and A8-series APUs are pretty great options.

However, games aren't the only activity where a capable on-board GPU can make your life easier.

GPU acceleration is a widely-used term which boils down to letting a computer's GPU take on specific work that would otherwise be performed on the CPU. This has numerous benefits: it can provide speed increases for everything from video playback to running Flash games to video encoding, while also freeing up the CPU to keep your PC snappy and responsive.

You don't need a discrete graphics card to take advantage of it either – many programs already support GPU acceleration using Intel and AMD's on-board graphics. Here are a few examples:

Video encoding

Video encoding (sometimes called transcoding if you're converting a video from one compressed format to another, such as converting an .MKV

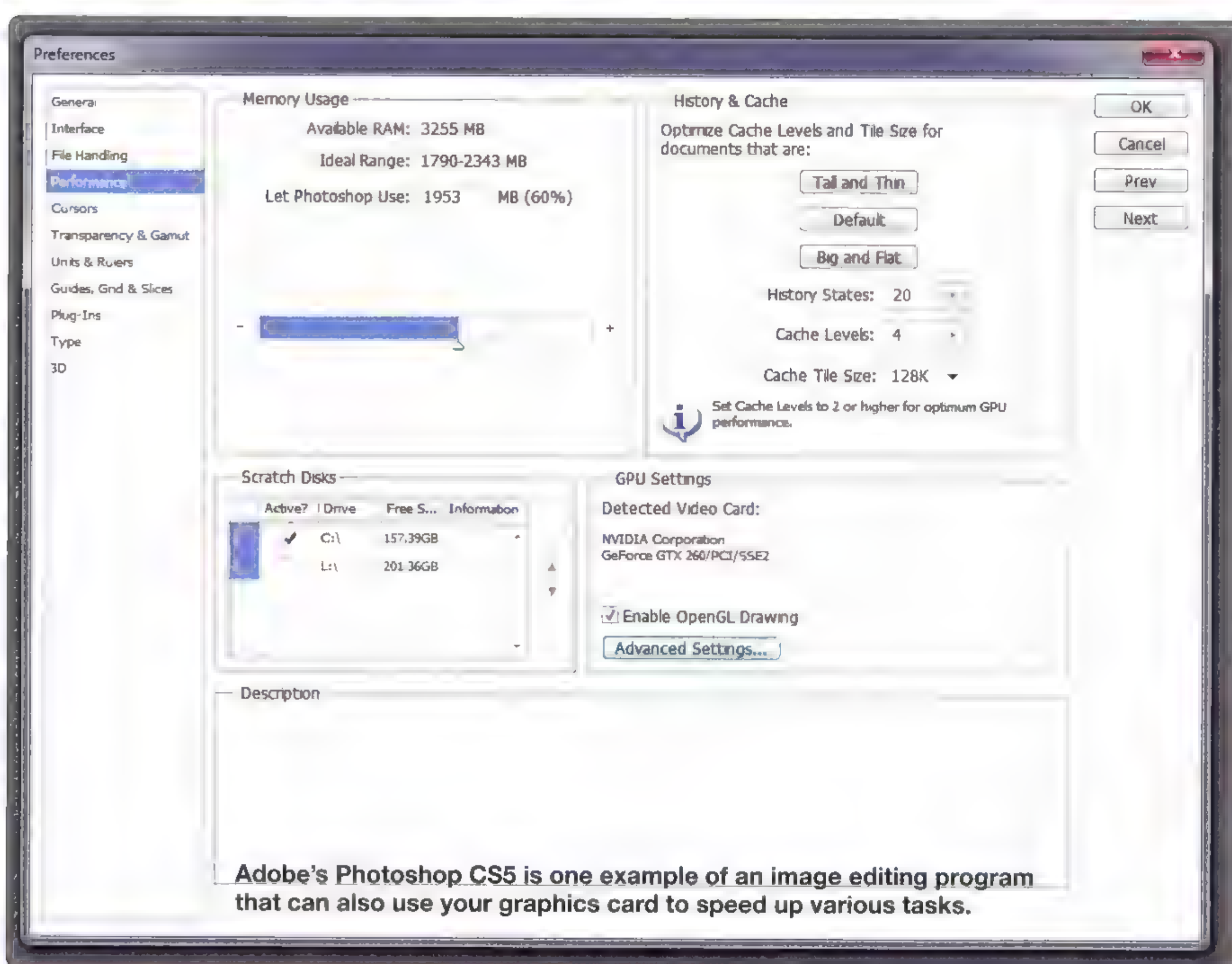
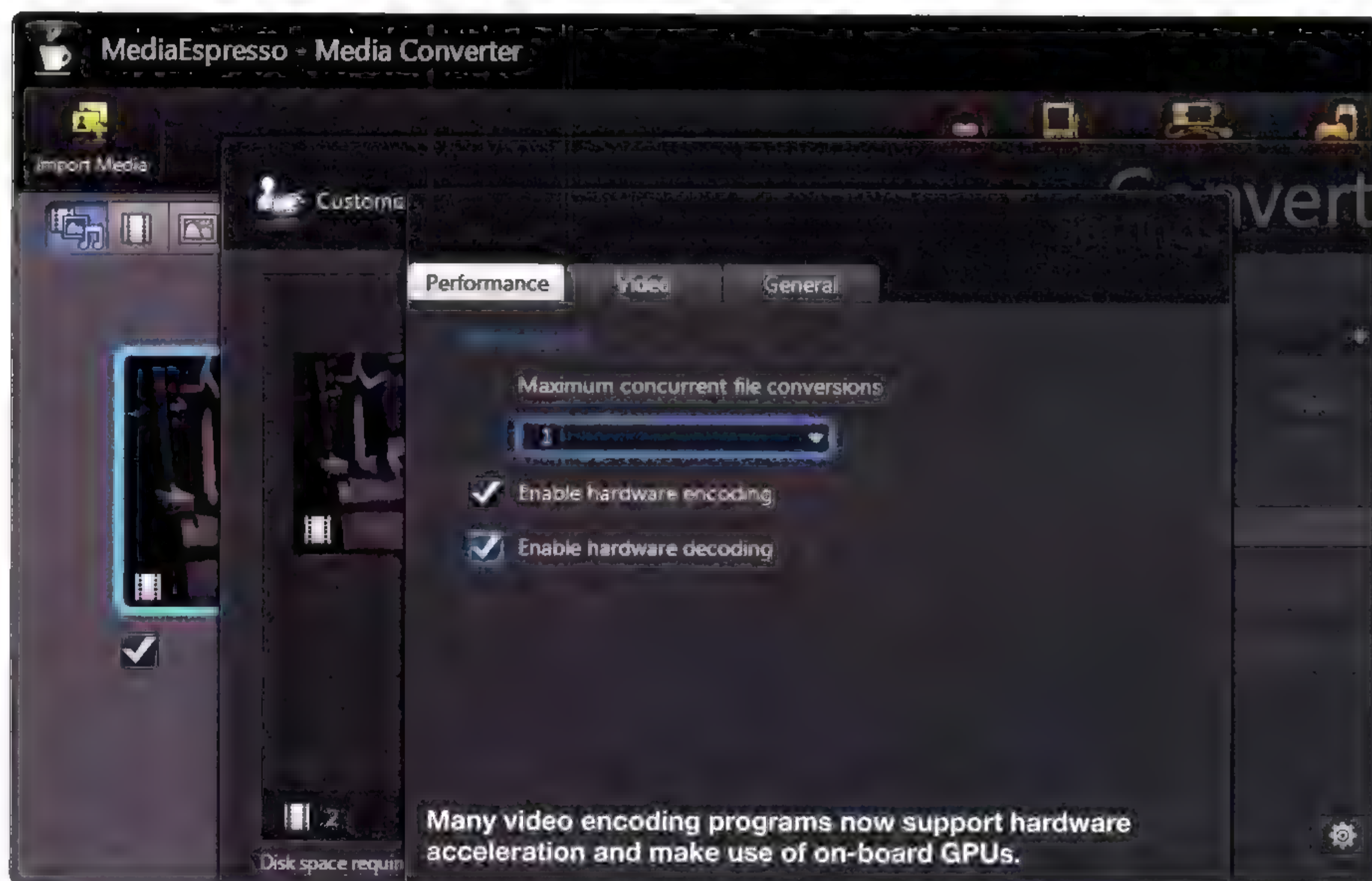
file to an .MP4 file) is a task at which GPUs excel. Thanks to their gaming origins they've been specially designed to deal with rendering pixels and colours in a massively parallel way. This lends itself extremely well to video encoding. We're familiar with the fact that quad-core CPUs usually perform much better than dual-core CPUs; though GPU 'cores' aren't individually equivalent, they can have many hundreds of cores available for use. Combined with the fact

that they're particularly suited to rendering pixels and colours, it may even be preferable to focus your finances on your graphics card, rather than CPU, if you perform a lot of video encoding. In many instances, your GPU may well complete the task quicker, and may also consume less power overall.

This could be particularly useful if your PC is built around one of the GPU-equipped CPUs we've tested this month; as they're low-end processors without much grunt, dumping a large video encoding task onto them could well see your system suffer when it comes to multi-tasking.

To find out if the best CPUs in this month's Head2Head benefited from using GPU acceleration with video encoding we ran a timed task, encoding a 200MB video file using CyberLink's MediaEspresso media converter, which supports the on-board GPUs of both the AMD A8-3850 and the Intel Core i3-2100.

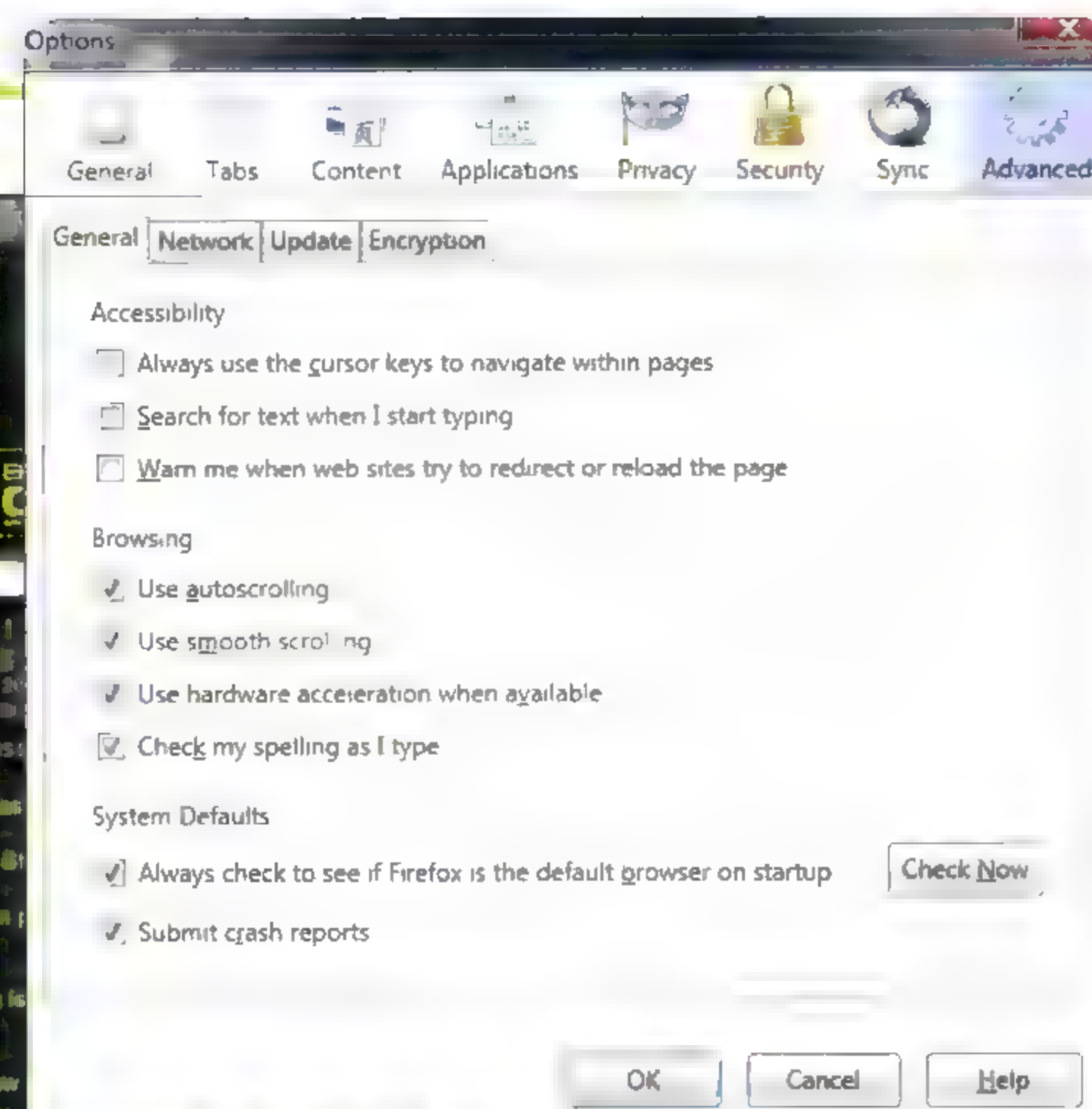
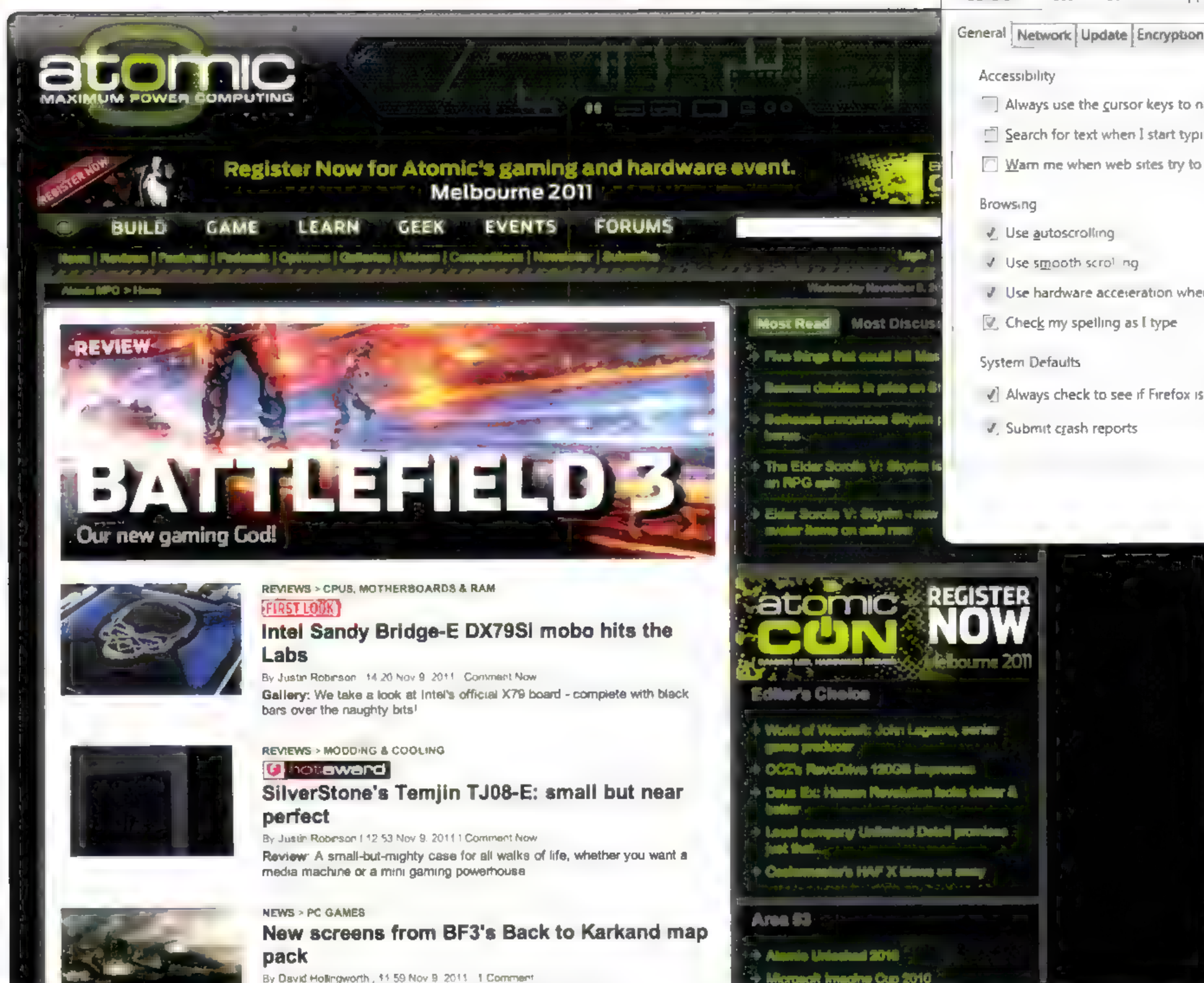
We first ran the task on the CPU alone, turning off the hardware acceleration option, which completed in 27 seconds on the A8-3850.



Cyberlink MediaEspresso



- Hardware acceleration disabled
- Hardware acceleration enabled



Many current browsers support hardware acceleration – Firefox allows you to toggle this on and off under the tools and options menu.

Video playback enhancements

Both the A8-3850 and the i3-2100 can use their on-board GPUs to upscale the resolution of DVDs for high-definition playback, and offer similar tweaks and optimisations that you'd expect to see with a discrete graphics card. You can control colour saturation, flesh tone correction, deinterlacing and noise reduction, although these options vary between different GPUs.

AMD's new APUs also have the ability to apply on-the-fly video stabilisation. Called Steady Video, the feature is located in the Vision Engine Control Center, which looks like the Catalyst Control Center we're familiar with when using Radeon graphics cards. Steady Video can be found in the same way (right clicking on the desktop is the quickest) and is useful if you're watching home video footage filmed by a drunk uncle.

Enabling hardware acceleration saw this time nearly cut in half to just 16 seconds. The Core i3-2105 saw an even greater benefit, with the time it took to encode the video falling by more than 61 per cent, from 23 seconds to just 7 seconds.

This result initially looks out of place, given that Intel's on-board graphics proved to be so poor in our game tests. However, Intel has added specific hard-coded logic into its Sandy Bridge processor design for dealing with video encoding (and video playback) as part of its Quick Sync Video hardware.

As well as helping to encode video in the background as we tested above, GPUs are obvious candidates for increasing the rate at which pixels encode in real time. For example, Adobe's Photoshop CS5 can use your GPU to smooth the zoom, pan and rotate functions when you're editing images, speeding up the work process.

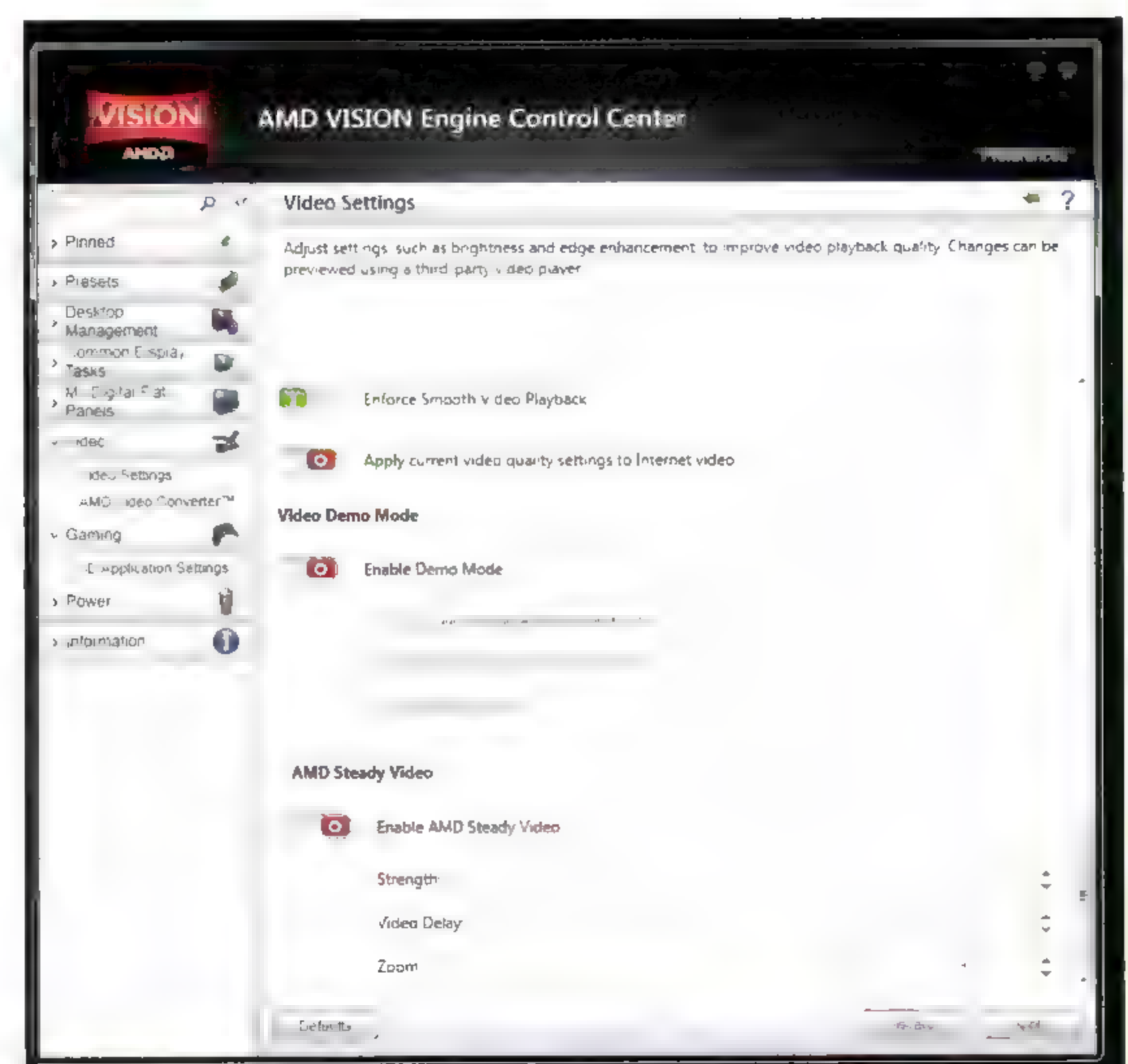
Many video editing programs also support GPU acceleration to allow you to generate previews of edits much quicker than if you used your CPU alone.

Browsers

An increasing amount of time we spend on our PCs involves clicking in browser windows, playing games and watching videos online. It was only a matter of time before companies such as Mozilla, Microsoft and Google took advantage of the extra horsepower with which most PCs are equipped.

Internet browsers such as Internet Explorer 9, Firefox 7 and the latest release of Chrome all use GPU acceleration to offload some of the work from your CPU to your graphics card. This has been employed in tasks such as video playback (eg YouTube), smoother scrolling, and speedier browsing on HTML5-heavy websites. Web browsers have also had a bump in speed thanks to Adobe Flash Player 11 (and onwards) now supporting GPU acceleration.

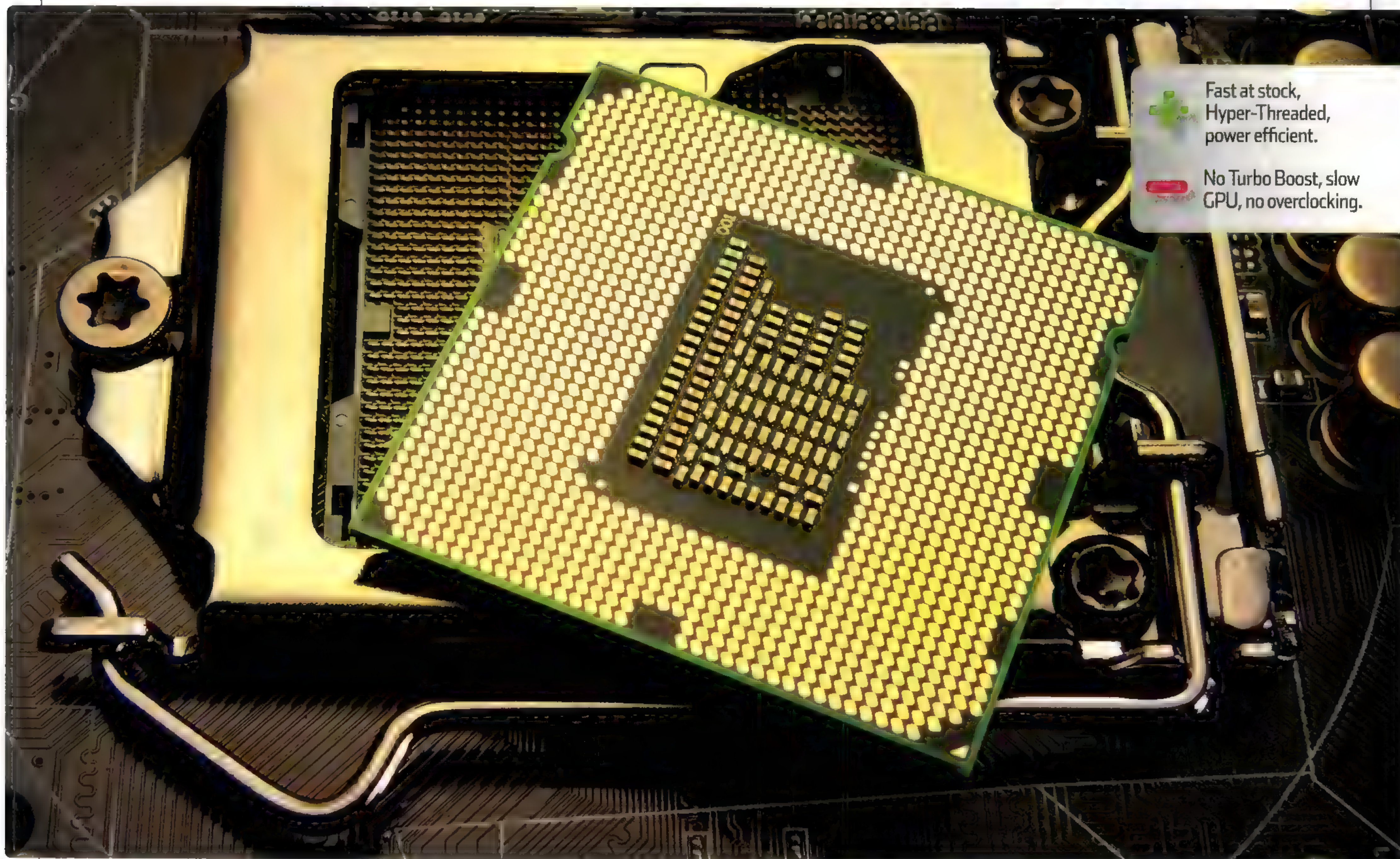
One of the success stories of low-power systems benefiting from GPU acceleration online is NVIDIA Ion systems. Intel Atom CPUs initially lacked the grunt needed to deal with the many demanding tasks the Internet demands of it – for example, providing smooth high-definition video playback (and even standard-definition wasn't much chop). By combining an Atom CPU with a GeForce 9400M GPU, NVIDIA revolutionised low-power devices such as net-tops and netbooks. They went from being only capable of light office tasks to being able to handle high-definition video playback and Flash-based games – tasks that usually ended in a stuttering mess when using an Atom CPU alone.





AMD's Lynx desktop APUs are configurable in its Vision Engine Control. Its Steady Video feature is located in the video settings.

Intel Core i3-2100 and Core i3-2105

Almost-identical twins.



 Fast at stock, Hyper-Threaded, power efficient.

 No Turbo Boost, slow GPU, no overclocking.

Street Price i3-2100 \$130; i3-2105 \$170

Website <http://tinyurl.com/Core2100>

Specifications 2 x 'Sandy Bridge' CPU cores @ 3.1GHz w/ Hyper-Threading; 6 'Intel HD2000 Graphics' cores @ 850-1100MHz (2105 has 12 'Intel HD3000 Graphics' cores @ 850-1350MHz); 64KB L1/core, 256KB L2/core, 3MB L3 shared; 65W TDP; integrated Northbridge; DDR3-1333 dual channel memory controller; DX10.1; Quick Sync; 32nm HKMG process; Socket LGA1155

The Core i3-2100 and 2105 each have a pair of identical 3.1GHz Sandy Bridge cores, and both are rated at a TDP of 65W.

As with the other cheap Intel CPUs, they boast a 3MB pool of shared L3 cache, along with a pair of 256KB L2 cache pools (one for each core) and a pair of dedicated 64KB pools of L1 cache (again, one per core). The main advantage the i3-2100 and i3-2105 offer is Hyper-Threading. They generate two logical cores from their pair of physical cores, with four cores appearing to the operating system. In theory this should give them a boost in multithreaded tasks, although it's slower than having four physical cores, as with the Phenom II X4 955 BE and the A-series APUs.

The on-board GPU is the only notable physical difference between the CPUs – the cheaper i3-2100 carries an Intel HD Graphics

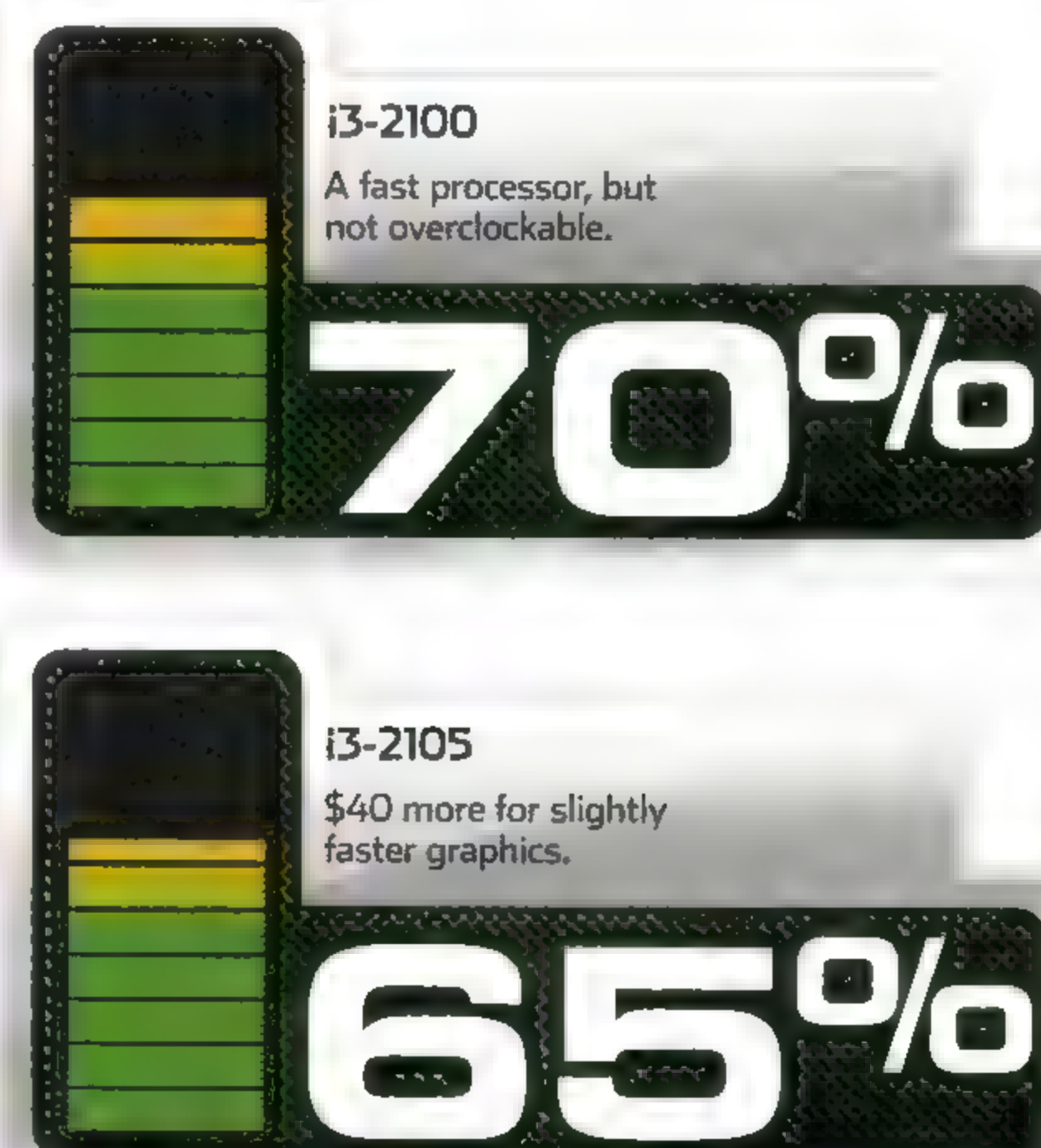
2000 GPU, while the i3-2105 is equipped with an HD Graphics 3000 GPU. The HD 3000 variant has double the number of cores – or EUs, as Intel prefers to describe them – of the 2000 version (12 as opposed to six).

This made no little to no difference in our 2D benchmarks, meaning that the two processors performed identically in wPrime, Cinebench 11.5 and our Media Benchmarks. Given their price, the two Core-i3s were never far from the top of the table, both posting an overall score of 1,488 in our Media Benchmarks. Only the heavily overclocked Phenom II X4 955BE was able to beat them – but it drew more than twice as much power from the wall – 400W compared to just 177W at full load.

Gaming performance without a discrete GPU was dire, but coupled with a graphics card they rocketed up the results table. A drop-off in performance occurred at the higher of our two game-test resolutions, where CPUs with four physical cores had an advantage, but the two CPUs still managed playable frame rates.

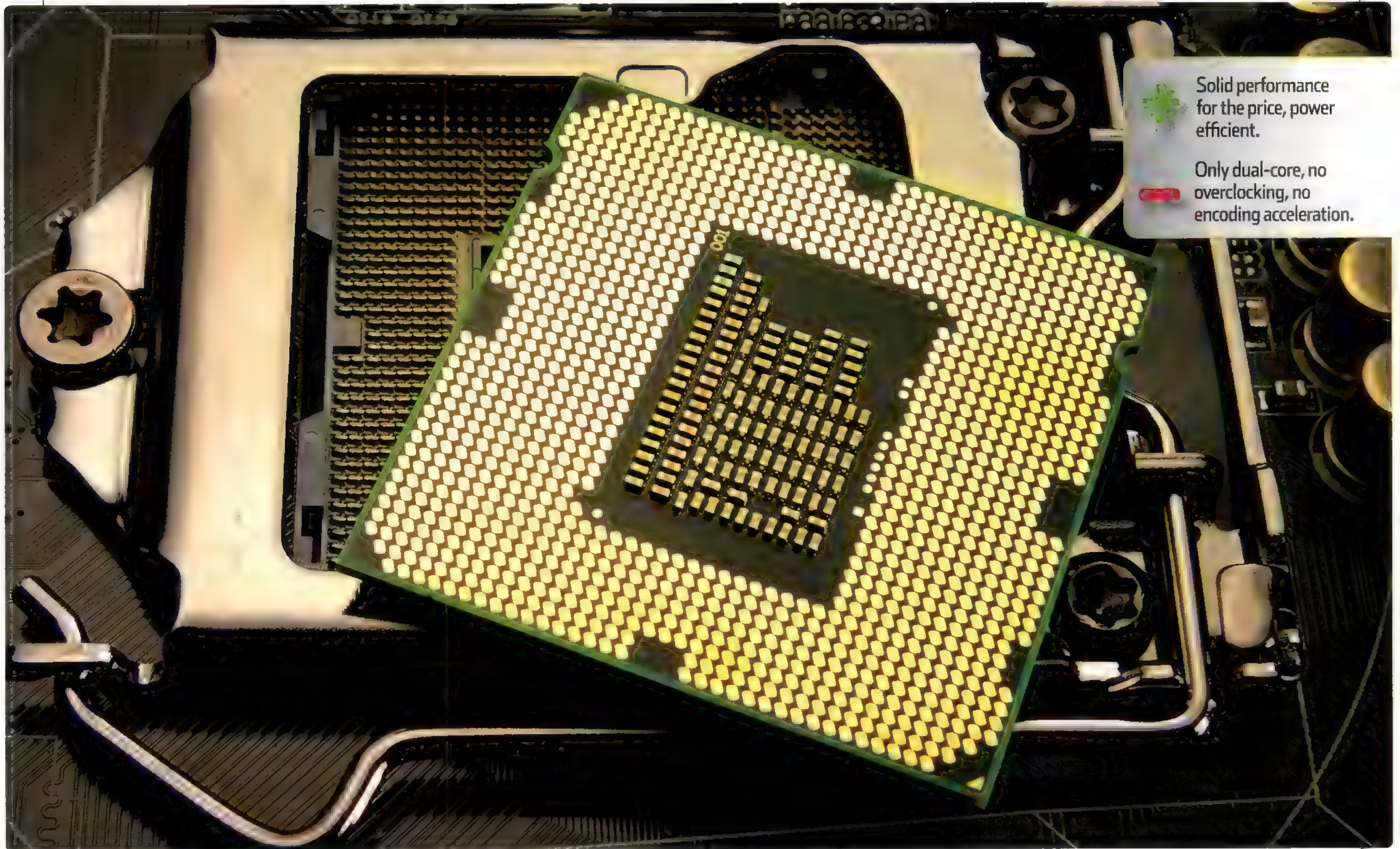
In 2D applications the Core i3s proved to be the best budget processors. They're also very power-efficient, but they become slightly less attractive when you throw 3D performance into


the mix, as their on-board GPUs are meagre. This means that you'll need to buy a discrete GPU for gaming on a Core-i3 system – an added cost, which makes the AMD A8-3850 a more tempting purchase. We also do not think it is worth spending the extra \$40 for the 2105 – the six extra EU cores don't add much – put it towards a graphics card instead.




Intel Pentium G620

It's all about the Pentiums, baby.



 Solid performance for the price, power efficient.

 Only dual-core, no overclocking, no encoding acceleration.

Street Price \$75

Website <http://tinyurl.com/PentG620>

Specifications 2 x 'Sandy Bridge' CPU cores @ 2.6GHz; 6 'Intel HD2000 Graphics' cores @ 850-1100MHz; 64KB L1/core, 256KB L2/core, 3MB L3 shared; 65W TDP; integrated Northbridge; DDR3-1066 dual channel memory controller; DX10.1; 32nm HKMG process; Socket LGA1155

Costing just \$75, the Pentium G620 is the cheapest LGA1155 CPU currently available (and second-cheapest in this group), but what do you get for your relatively small outlay? Well, as with the other Pentiums in this Head2Head, the G620 is based on the same Sandy Bridge design as Intel's excellent Core i5 and Core i7 LGA1155 CPUs. This is good, as it means that the G620 should share the same high performance and excellent efficiency for which we've praised the high end of the LGA1155 processor range in the past.

You miss out on a couple of major features with the G620, as it lacks the Turbo Boost function of Intel's top-end chips and even lacks the Hyper-Threading that the Core i3-2100 boasts. As a result, Windows will only recognise two cores when presented with the G620, rather than the four threads that the

i3-2100 presents. Each of the G620's 2.6GHz cores has access to a 64KB L1 cache and a 256KB L2 cache, and both share a larger 3MB pool of L3 cache.

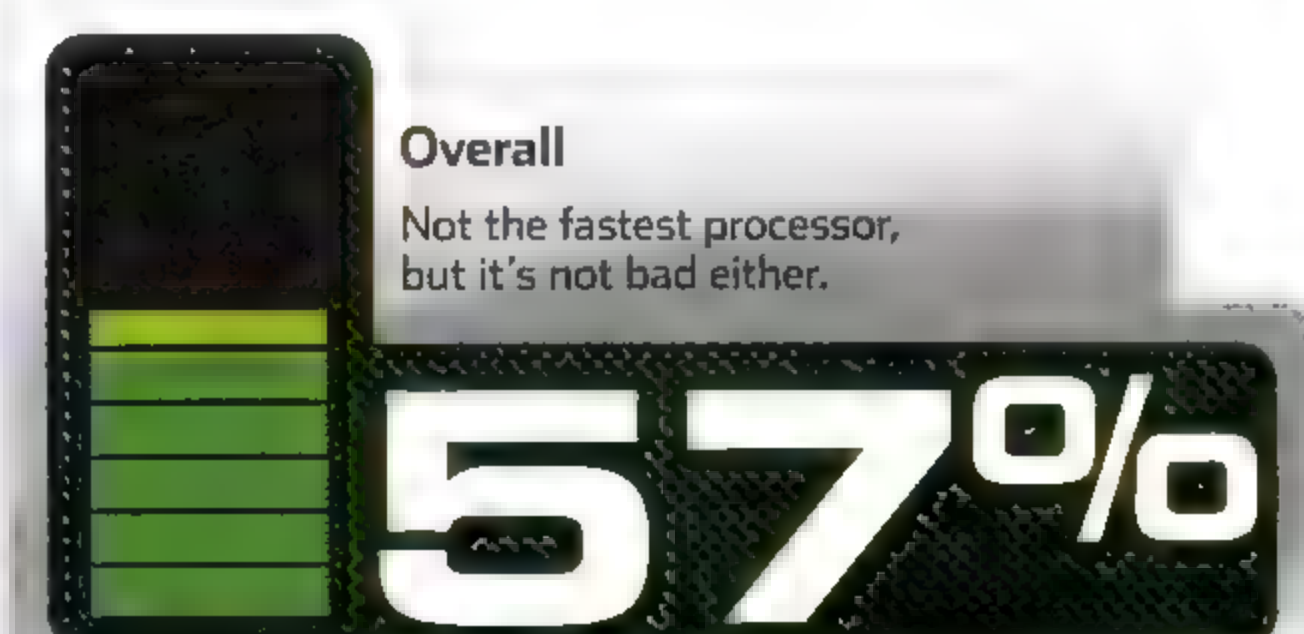
The G620 loses out again when it comes to memory support, as the maximum memory speed that its on-board controller can handle is 1066MHz DDR3. This compares badly to the 1333MHz memory that the other Intel processors can support, and the 1866MHz RAM that AMD's A-series APUs can address.

The performance of the G620 was disappointing in wPrime and Cinebench 11.5, with the processor only marginally ahead of the cheaper X2 250 in the latter test, and slightly slower than it in the former. It fared better in our Media Benchmarks, though, which respond better to processors with higher Inter-Process Communication. The G620 streaked ahead of all the AMD processors in the image editing test before falling back in the heavily multithreaded video encoding test. Its final score of 1,153 was just ahead of the A8-3850's, indicating that the G620 would be the better buy for non-gamers, as it costs half as much as the AMD APU.

Our 3D testing proved bittersweet for the G620 – without our test HD 6850 installed, performance was terrible. The integrated Intel

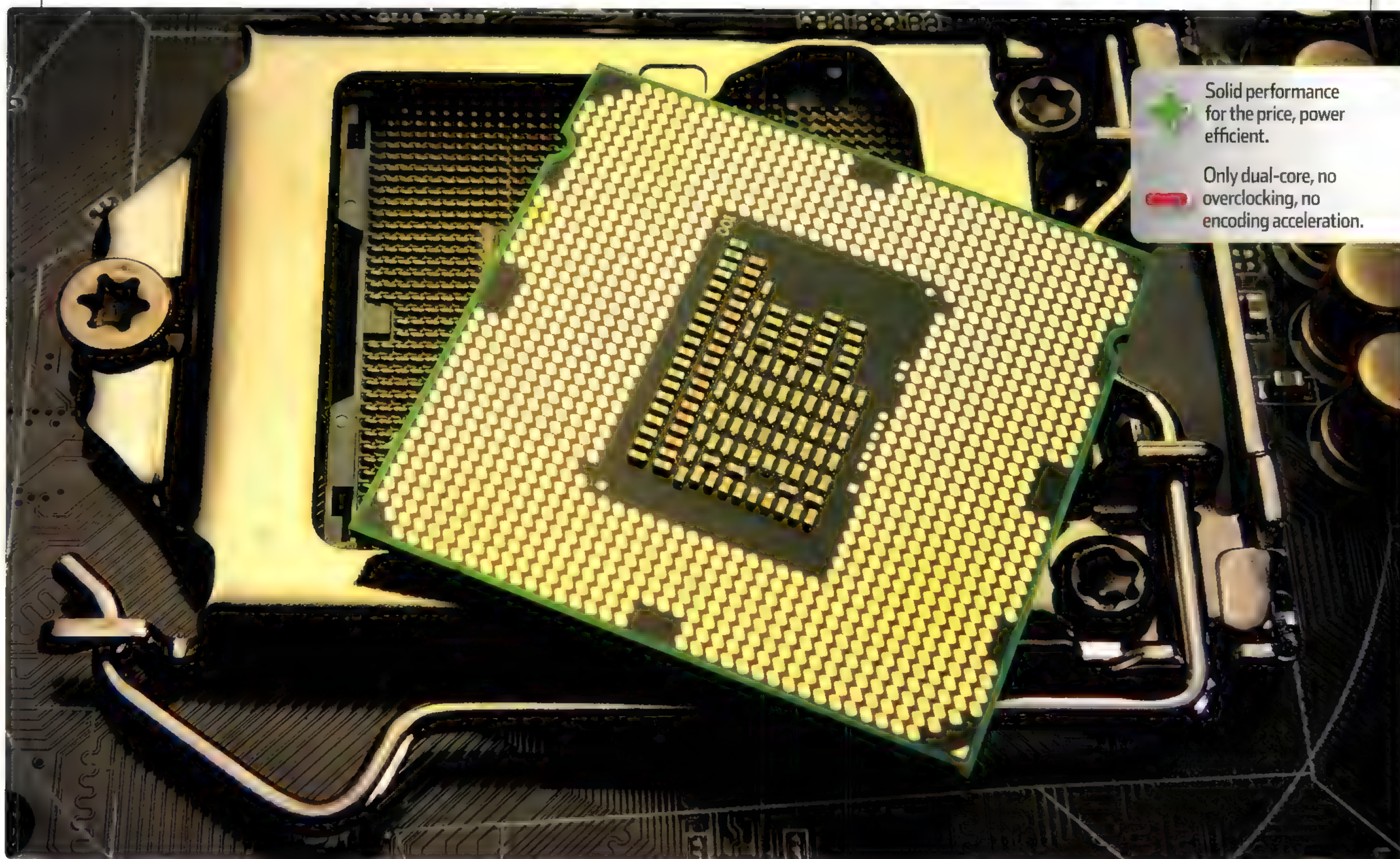
HD graphics of the G620 couldn't manage a double-digit frame rate in either of our test games, indicating that it's of little use for GPU-accelerated applications – and it doesn't even come with Quick Sync video enhancement hardware. Performance with a graphics card installed was relatively good, as the G620 continually outperformed the similarly priced AMD dual-core CPUs, while posting the lowest peak power draw too.


If you only have around \$80 to spend on a CPU but just want to run 2D applications, then the G620 is a good choice. It's reasonably fast at non-gaming applications and leaves an upgrade path to LGA1155 processors such as the Core i5-2500K and even Intel's forthcoming Ivy Bridge range.

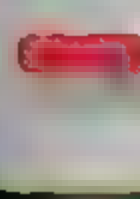


Intel Pentium G840 and Pentium G850

Basically the same processor with a different number.



 Solid performance for the price, power efficient.

 Only dual-core, no overclocking, no encoding acceleration.

Street Price G840 \$90; G850 \$95

Website <http://tinyurl.com/PentG850>

Specifications 2 x 'Sandy Bridge' CPU cores @ 2.8GHz (G850 has 2.9GHz); 6 'Intel HD2000 Graphics' cores @ 850-1100MHz; 64KB L1/core, 256KB L2/core, 3MB L3 shared; 65W TDP; integrated Northbridge; DDR3-1333 dual channel memory controller; DX10.1; 32nm HKMG process; Socket LGA1155

The Intel Pentium G840 and Pentium G850 are both based on the same dual-core Sandy Bridge design and have a TDP of 65W. They also sport the same DirectX 10.1-compliant Intel HD Graphics integrated graphics, which runs at 850MHz in each of the CPUs.

They also share the same amounts of L1, L2 and L3 cache. Their rated clock speeds – the G840 runs at 2.8GHz while the G850 runs 100MHz faster at 2.9GHz – are the only discernable differences.

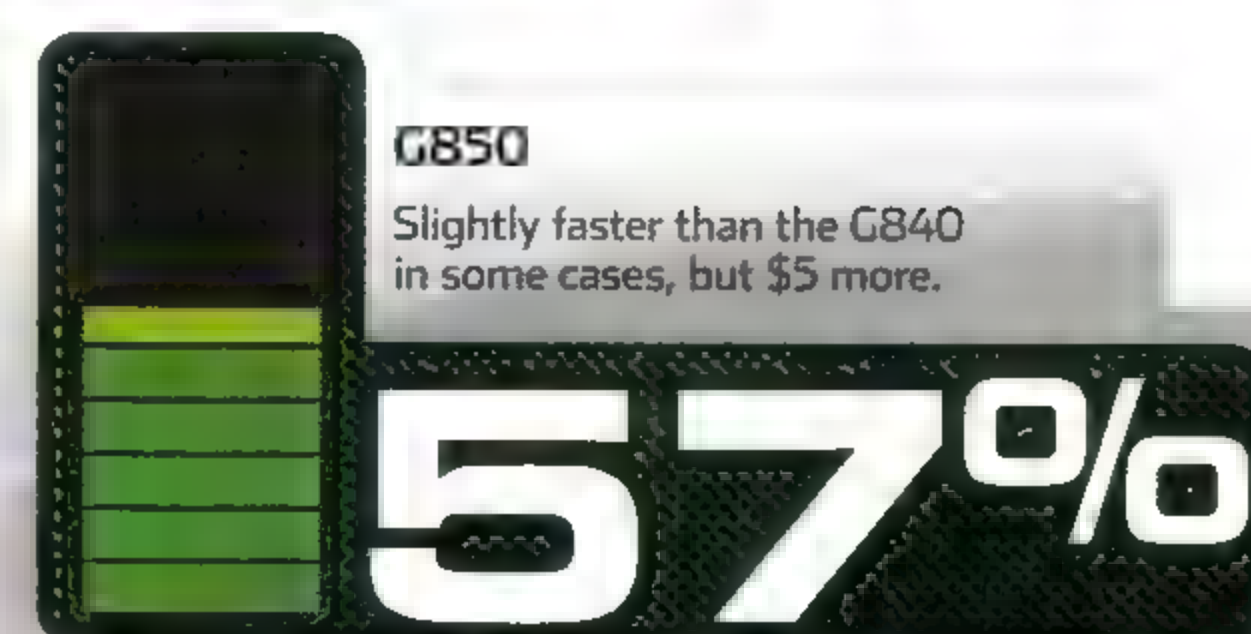
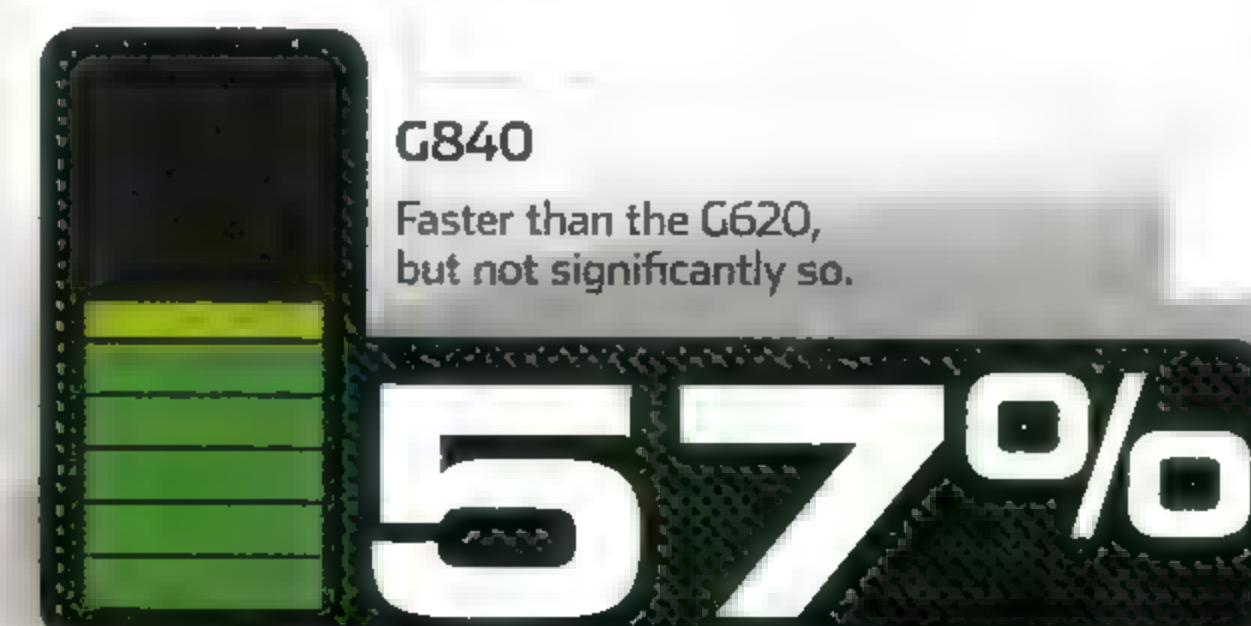
Lacking Intel's new K designation, their frequency multipliers are locked. Intel's low-end processors have a history of being overclocking monsters – not this time around, and Intel obviously wants to drive PC enthusiasts towards its more expensive processors. We weren't surprised to see the CPUs perform similarly. They were similarly slow in wPrime and Cinebench 11.5, with the

G850 making little use of the extra 100MHz of clock speed available to it.

Our Media Benchmarks initially told a similar story, as the two processors were again largely inseparable in our image editing test. Thankfully for the G850, this changed in the video encoding test, which is the most CPU-intensive of our media tests, as it managed a healthy 168-point lead over the G840, also bettering it overall. Both processors were slower than the Hyper-Threaded Core i3s, as well as the Phenom X4 955 and Phenom X2 560 BE at their overclocked settings.

Predictably, the two processors capitulated emphatically when using their on-board GPUs and presented with a game to play. You'll need to buy a graphics card if you plan to game on a system built around either of these CPUs. Again these processors do not come with Intel Quick Sync video acceleration hardware. Performance with our discrete graphics card was reasonable, however, with both CPUs managing a minimum frame rate of at least 34fps in all of our game tests. Again, they performed similarly to each other, although the G850 had a slight advantage in Arma II, which seems to love extra CPU frequency. The two G800-series CPUs

are competent performers in applications but absolutely need a graphics card for games. The same isn't true of the AMD A8-3850, which can play games while also being competent in applications. As a result, the latter is the better buy unless you already own or plan to buy a discrete GPU, or want to get into the LGA1155 platform.



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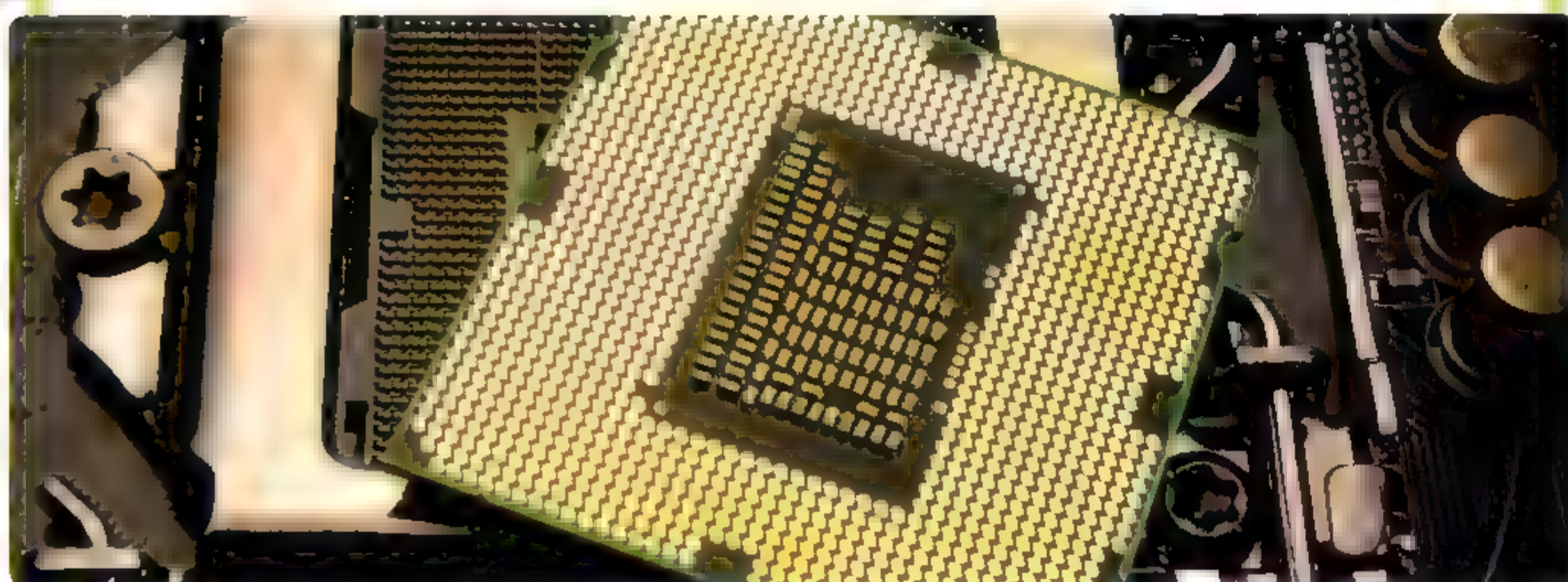
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Available at these excellent resellers and many more!

What to buy

It can still be confusing with such an array of choice, especially with similarly-named and specced processors, so we've picked four typical users and picked a CPU for each – see which one you fit into below.

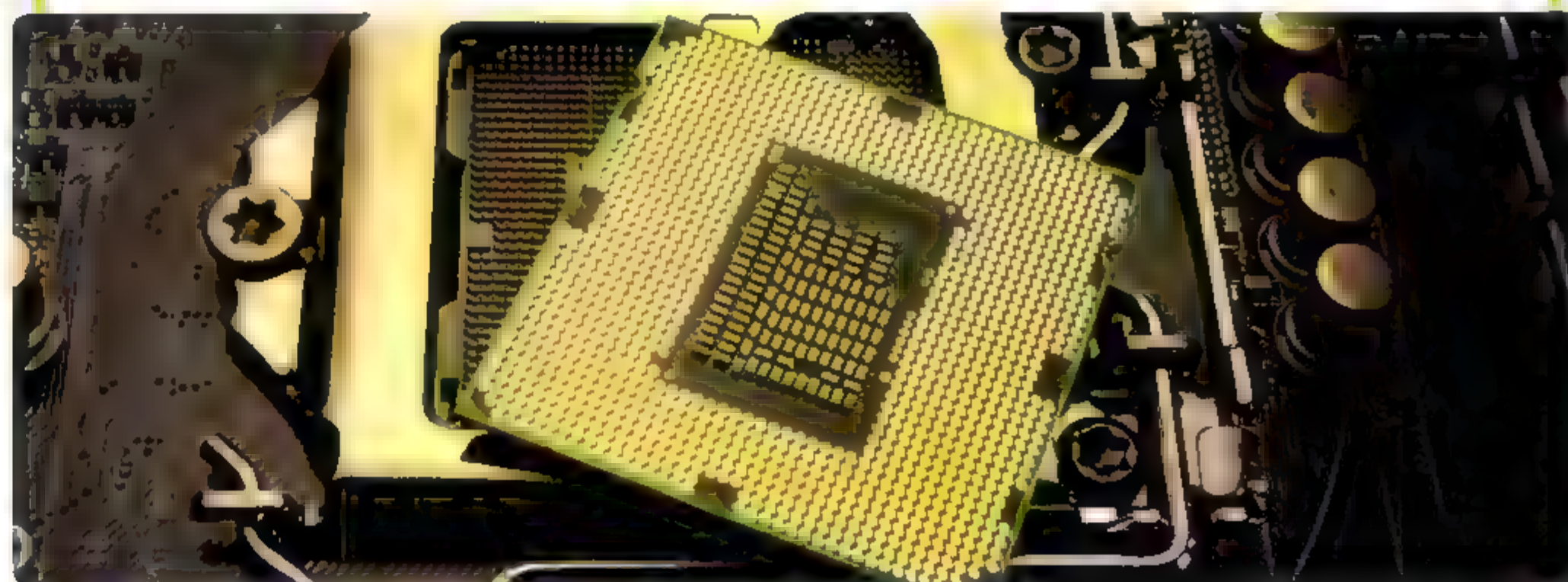
You want to spend the smallest amount without skimping on quality



Intel Pentium G620 (PG 63)

Intel's Pentium G620 costs just \$75 but managed respectable results in most of our tests, unlike AMD's cheap offerings. While Intel Core i3 CPUs have a clear edge in applications, if you aren't into gaming and just need a CPU that's cheap and fast, you can't go wrong with the G620. Its on-board GPU isn't suitable for 3D gaming, but it means that you won't have to spend money on a discrete graphics card if all you need is a Windows desktop, YouTube, or some idle Flash-based gaming. Make sure you buy an LGA1155 motherboard with an H- or Z-series chipset to access its on-board graphics – an H-series board will be cheaper and a better match.

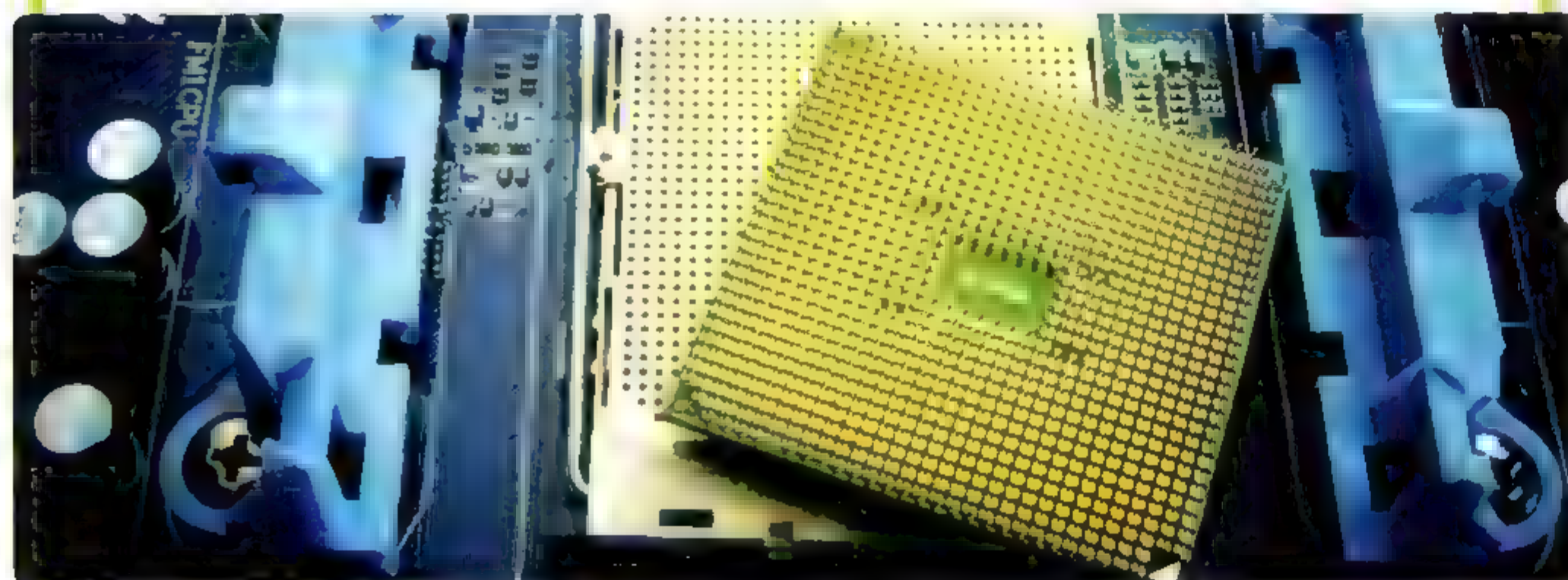
You want application speed but don't need graphical grunt



Intel Core i3-2100 (PG 62)

Intel's Core i3-2100 is a fantastic CPU for \$130. It's fast in demanding applications such as video and photo editing, and just missed the top spot overall in our Media Benchmarks performance graphs. The Core i3-2100 is also very power-efficient. While its on-board graphics can't play games, the i3-2100 is fine for a Windows desktop, media playback, GPU-accelerated video encoding and casual Flash games. It can even run dual screens for higher productivity! Paired with an H-series motherboard (Z68 will be relatively pricey) you'll have plenty of speed for under \$300.

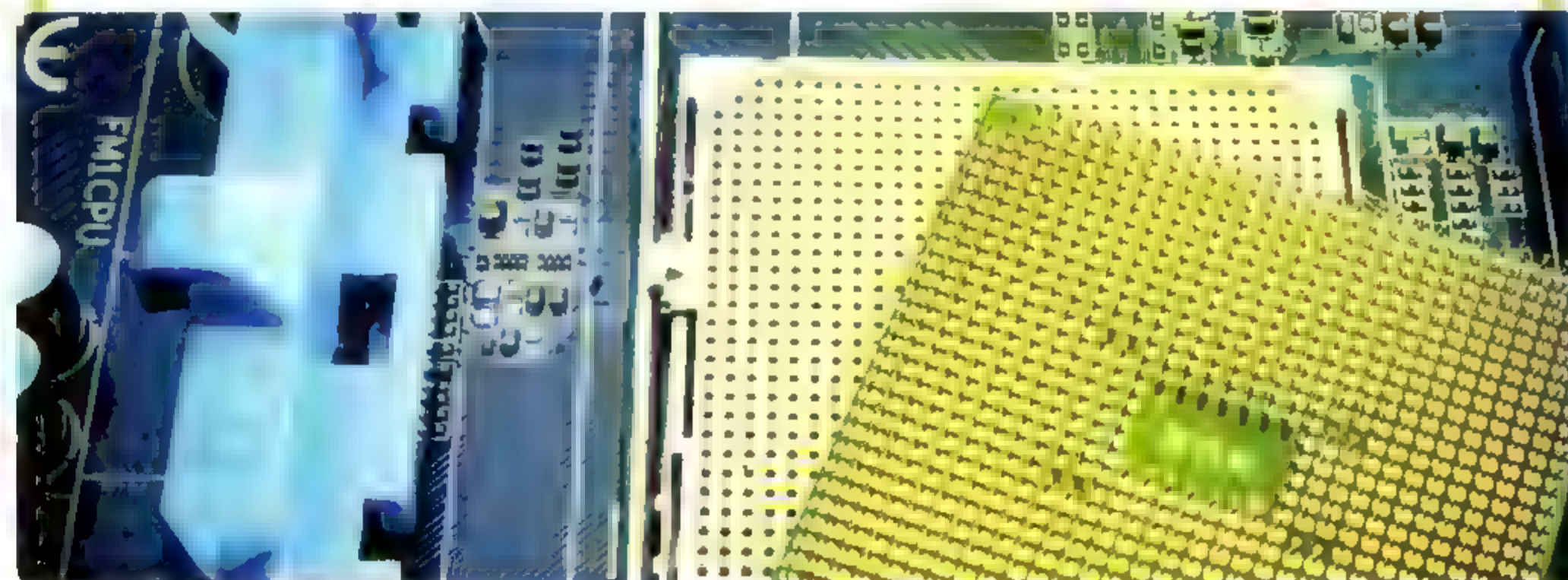
You play games infrequently, but often enough to want 3D



AMD A8-3850 (PG 54)

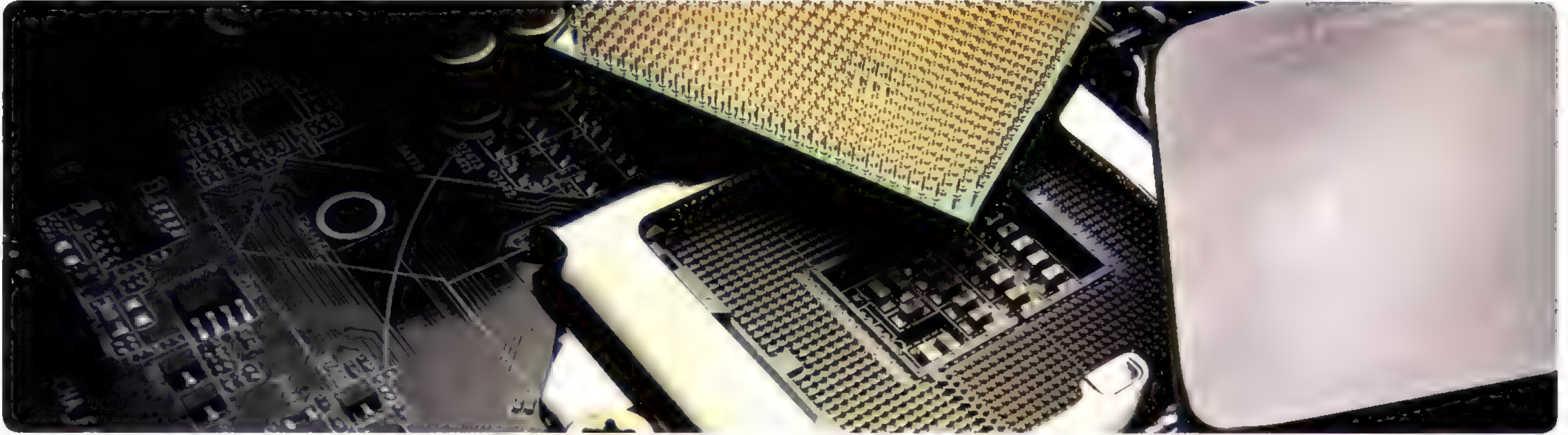
While Intel processing cores are faster at demanding tasks such as video and image editing, their on-board GPUs are useless for 3D games. As such, you'd need to fork out for a capable graphics card if you opt for the Core i3-2100. However, the AMD A8-3850 managed playable frame rates in Arma II at 1280 x 720 with high settings. This is a massive feat for a system with a \$150 processor with no separate graphics card, and means that less demanding games should prove no trouble. You'll need to pair it with an FM1 motherboard rather than a Socket AM3 or Socket AM3+ model, then away you go.

You play 3D games frequently but have limited funds



AMD A8-3850 (PG 54)

There's little doubt that you need a discrete graphics card if you're serious about gaming at high resolutions with high detail settings, and AA and AF enabled. With a Radeon HD 6850 1GB graphics card, the AMD A8-3850 easily managed playable frame rates in both our game tests, even at 1920 x 1080 on high settings. As an added bonus, unlike any of Intel's budget CPUs, the A8-3850 can be overclocked, yielding even more performance. It should also fare better with future games than Intel's budget processors, as it has four cores rather than two.



AMD CPUs

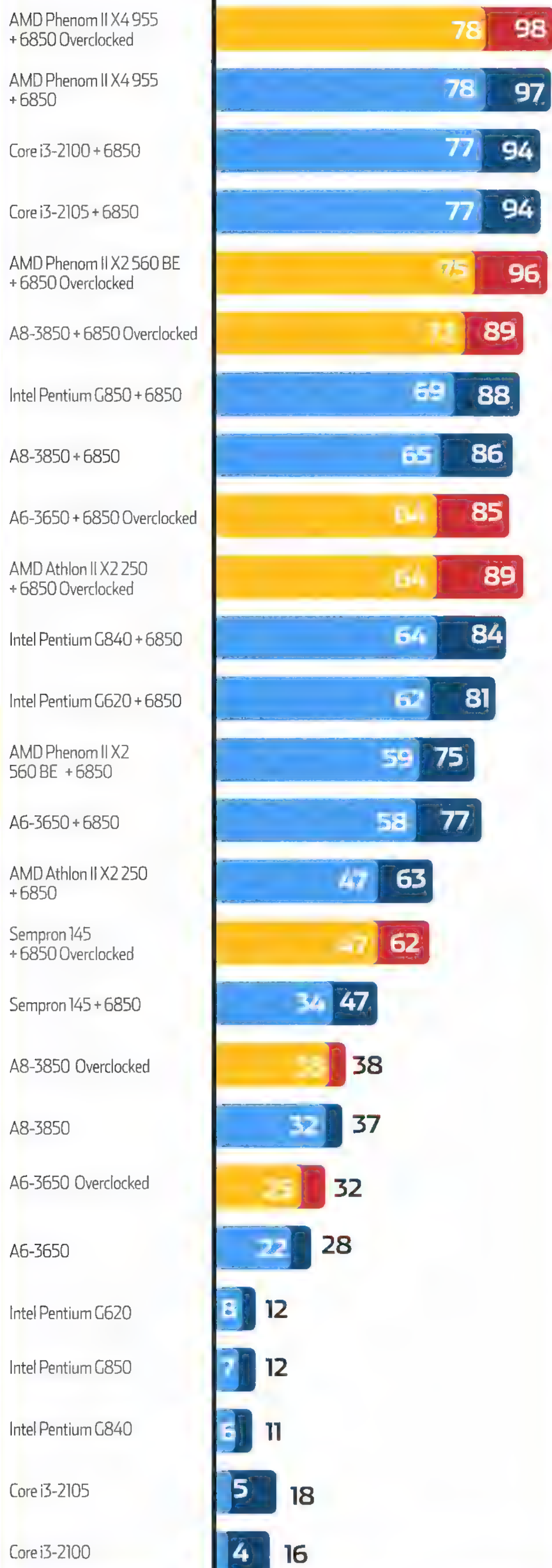
| | AMD A6-3650 | AMD A8-3850 | AMD Athlon II X2 250 | AMD Phenom II X2 560 BE | AMD Phenom II X4 955 BE | AMD Sempron 145 |
|-----------------------|---|---|---|---|---|---|
| Price | \$130 | \$150 | \$85 | \$120 | \$150 | \$42 |
| Product website | http://tinyurl.com/AMDAPU | http://tinyurl.com/AMDAPU | http://tinyurl.com/AMDX2-250 | http://tinyurl.com/AMDX2-560 | http://tinyurl.com/Phen955 | http://tinyurl.com/Semp145 |
| Packaging | FM1 | FM1 | Socket AM3 | Socket AM3 | Socket AM3 | Socket AM3 |
| Frequency | 2.6GHz | 2.9GHz | 3GHz | 3.3GHz | 3.2GHz | 2.8GHz |
| Max Overclock | 3GHz | 3.33GHz | 4.2GHz | 4.25GHz | 4.2GHz | 3.9GHz |
| Core Design | Husky | Husky | Regor | Callisto | Deneb | Sargas |
| Number of Cores | 4 physical | 4 physical | 2 physical | 2 physical | 4 physical | 1 physical |
| Cache | 4x 128KB L1, 4x 1MB L2 | 4x 128KB L1, 4x 1MB L2 | 2x 128K L1, 2MB L2 | 2x 128K L1, 2x 512KB L2, 6MB L3 | 4x 128K L1, 4x 512KB L2, 6MB L3 | 128KB L1, 1MB L2 |
| TDP | 100W | 100W | 65W | 80W | 125W | 45W |
| GPU | HD 6530D | HD 6550D | - | - | - | - |
| Frequency | 443MHz | 600MHz | - | - | - | - |
| DirectX compatibility | 11 | 11 | - | - | - | - |

Intel CPUs

| | Intel Core i3-2100 | Intel Core i3-2105 | Intel Pentium G620 | Intel Pentium G840 | Intel Pentium G850 |
|-----------------------|---|---|---|---|---|
| Price | \$130 | \$170 | \$75 | \$90 | \$95 |
| Product website | http://tinyurl.com/Core2100 | http://tinyurl.com/Core2100 | http://tinyurl.com/PentG620 | http://tinyurl.com/PentG850 | http://tinyurl.com/PentG850 |
| Packaging | LGA1155 | LGA1155 | LGA1155 | LGA1155 | LGA1155 |
| Frequency | 3.1GHz | 3.1GHz | 2.6GHz | 2.8GHz | 2.9GHz |
| Core Design | Sandy Bridge | Sandy Bridge | Sandy Bridge | Sandy Bridge | Sandy Bridge |
| Number of Cores | 2 physical, 2 logical | 2 physical, 2 logical | 2 physical | 2 physical | 2 physical |
| Cache | 2x 64KB L1, 2x 256KB L2, 3MB L3 | 2x 64KB L1, 2x 256KB L2, 3MB L3 | 2x 64KB L1, 2x 256KB L2, 3MB L3 | 2x 64KB L1, 2x 256KB L2, 3MB L3 | 2x 64KB L1, 2x 256KB L2, 3MB L3 |
| TDP | 65W | 65W | 65W | 65W | 65W |
| GPU | Intel HD Graphics 2000 | Intel HD Graphics 3000 | Intel HD Graphics | Intel HD Graphics | Intel HD Graphics |
| Frequency | 850MHz | 850MHz | 850MHz | 850MHz | 850MHz |
| DirectX compatibility | 10.1 | 10.1 | 10.1 | 10.1 | 10.1 |

ARMA II: Operation Arrowhead

1280x720, High settings, no AA



■ Stock speed min ■ Overclocked min ■ Stock speed avg ■ Overclocked avg

Cinebench

AMD Phenom II X4 955 + 6850 Overclocked

4.8

A8-3850 Overclocked

3.57

AMD Phenom II X4 955 + 6850

3.8

A6-3650 Overclocked

3.57

A8-3850

3.45

A6-3650

3.08

Core i3-2100

2.97

Core i3-2105

2.97

AMD Phenom II X2 560 BE + 6850 Overclocked

2.71

AMD Athlon II X2 250 + 6850 Overclocked

2.39

Intel Pentium G850

2.23

Intel Pentium G840

2.19

Intel Pentium G620

1.95

AMD Phenom II X2 560 BE + 6850

1.95

AMD Athlon II X2 250 + 6850

1.75

Sempron 145 + 6850 Overclocked

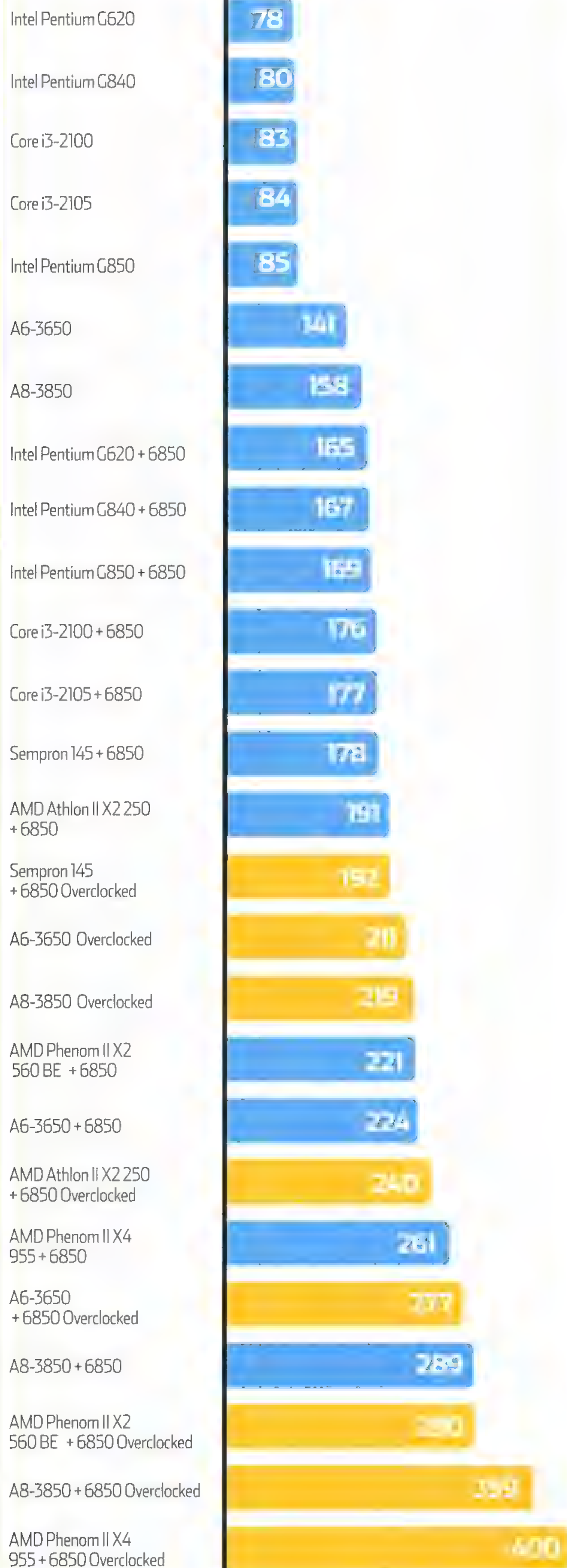
1.0

Sempron 145 + 6850

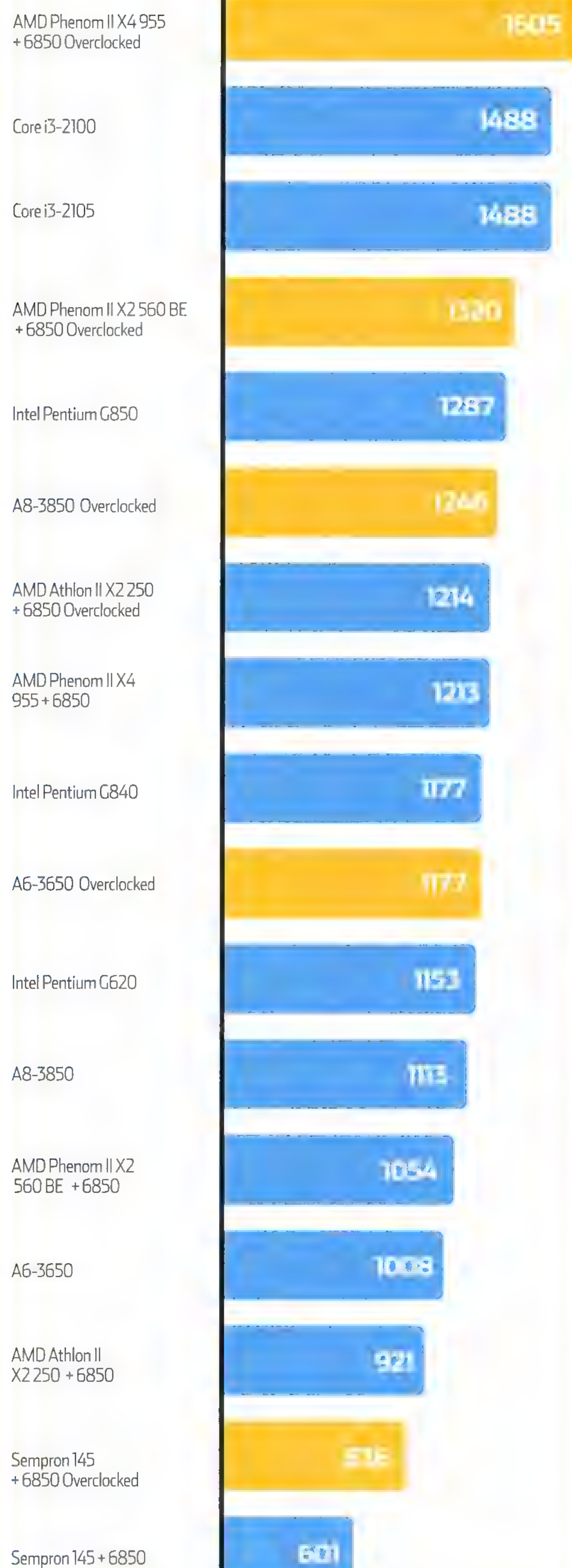
0.8

■ Stock speed ■ Overclocked

Power consumption load



Overall



■ Stock speed ■ Overclocked

KITLOG

These are four of our basic systems, with something for every taste. **The Game Box** is put together with money-saving in mind, but also an eye to getting as much bang for buck. Our build may be a little more expensive than what you could technically get away with, but for that extra few hundred you're also getting cutting edge performance and one of the most overclockable chips you can get today.

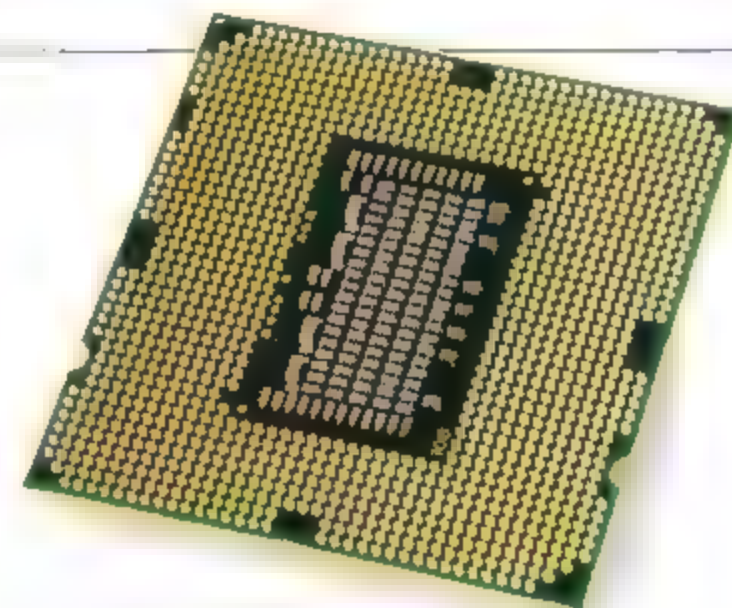
Some say that a mouse is a personal choice, and that no review will ever come close to satisfying everyone. But some mice are just good enough that this doesn't really matter – such as the below Sensei. It's customisable enough that no matter your preference you can make it feel just right and, assuming you're not left-handed, it'll likely serve you for years to come. Great Christmas pressie, too!

The Perfect PC, on the other hand, is the system everyone aspires to, with nothing but the best parts – without going crazy, though. It's a collection of all the greatest hardware that we'd pick without a budget, sure to impress with performance and sheer style.

Oh, and if you're wondering what the Ref IDs are, that's the ID of that article on our website. Just enter it like this – www.atomicmpc.com.au/?NUMBER – and you'll go straight to that review.

THE GAME BOX

CPU



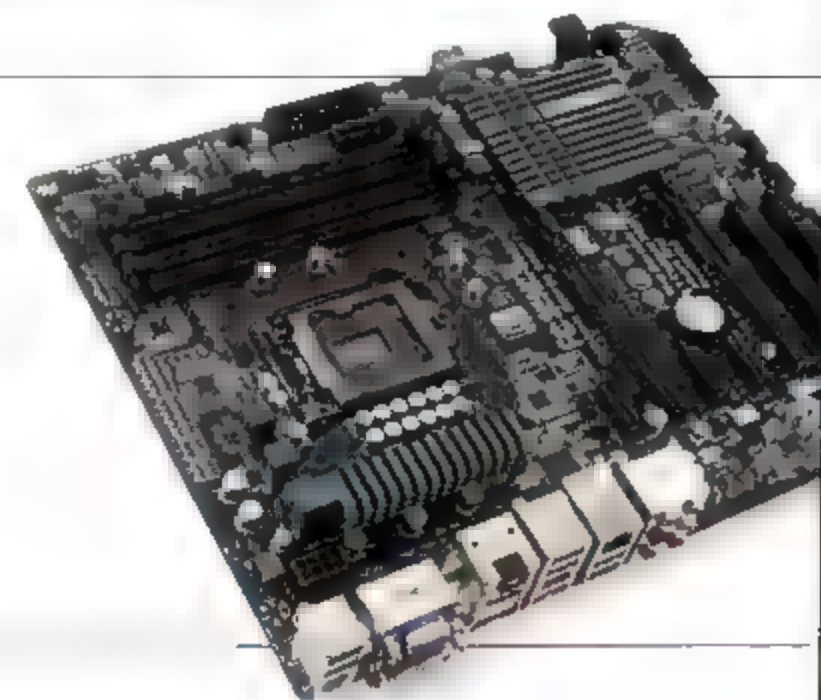
Intel Core i5 2500-K
PRICE \$220

Sandy Bridge's combination of cost and overclocking prowess is awesome.
Issue 122, Page 36

MOTHERBOARD

Gigabyte Z68X-UD3H-B3
PRICE \$170

Affordable gaming performance and features.
Ref ID: 263631



MEMORY



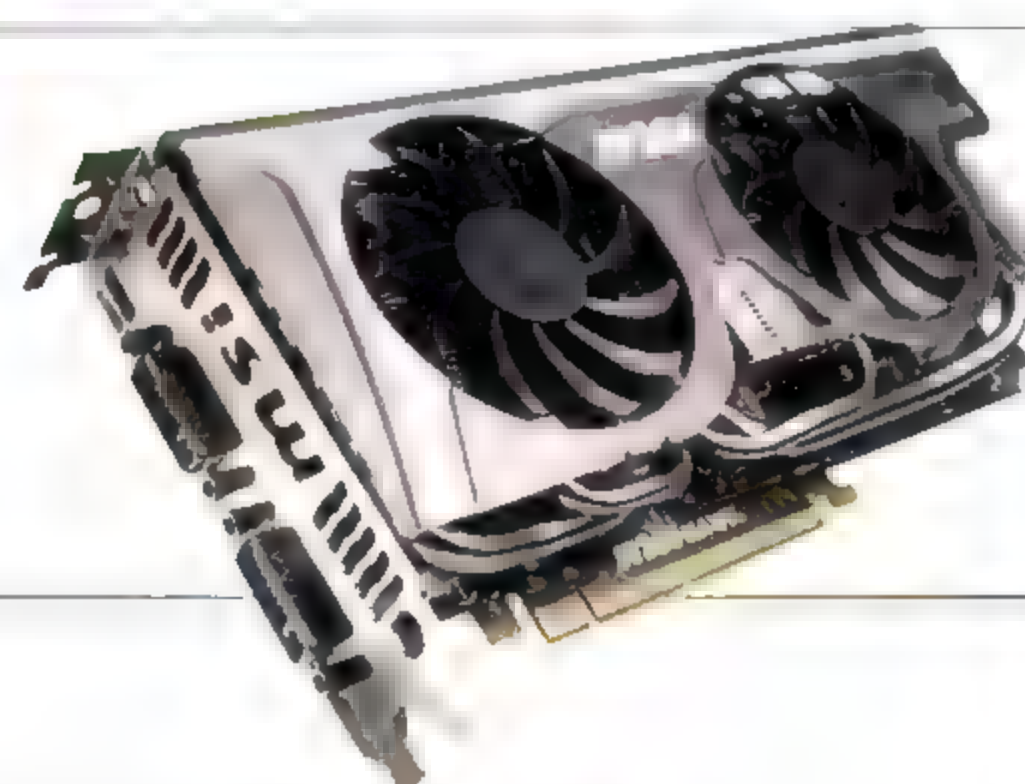
G.Skill Ripjaws F3-10666CL7D-4GBRH
PRICE \$45

Great value, tight timings, and some flexibility.

VIDEOCARD

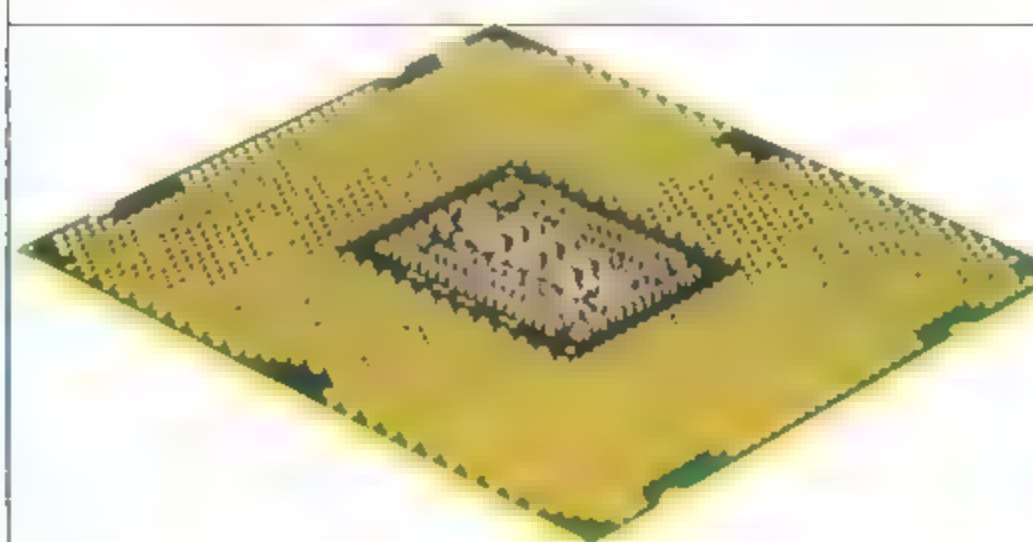
NVIDIA GTX560
PRICE \$220

A reference-design card, but plenty fast for gaming bliss.
Issue 116, Page 38



THE PERFECT PC

CPU



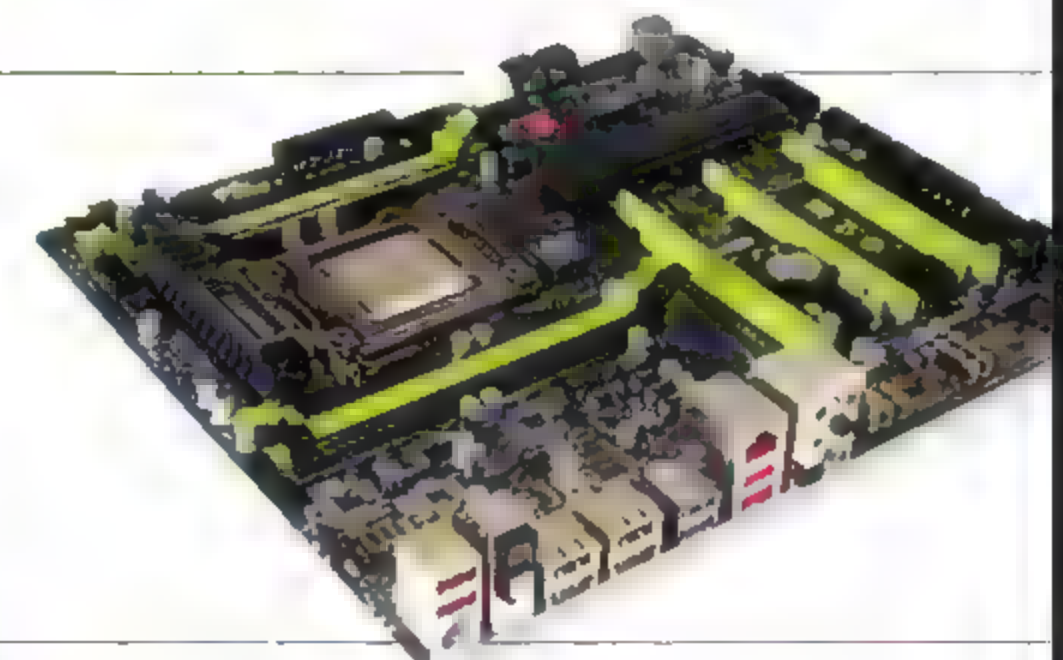
Intel Core i7 3930K
PRICE \$700

Six cores of Sandy Bridge-E loving. Overclock for justice!
Issue 132, Page 32

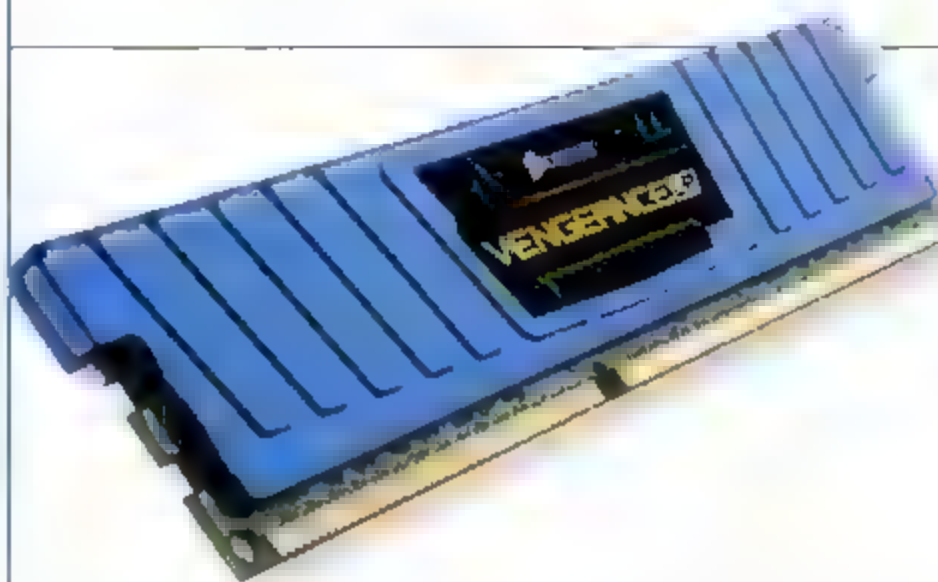
MOTHERBOARD

Gigabyte G1.Assassin 2
PRICE \$470

It's about as super-premium as you could get, or want.
Ref ID: 281856



MEMORY



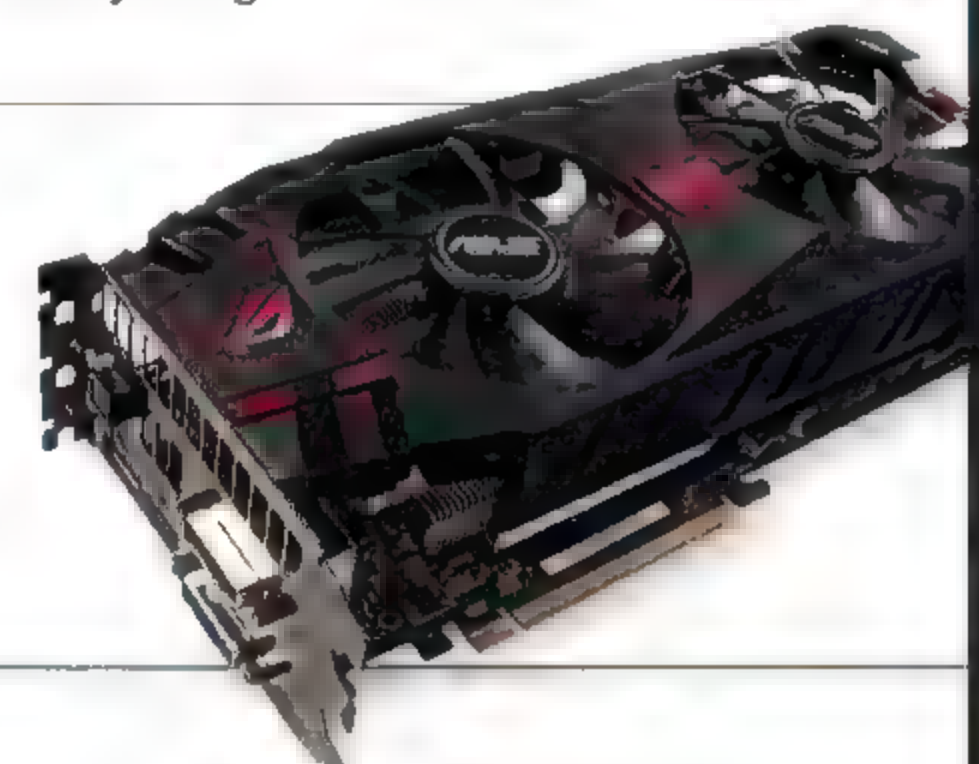
Corsair Vengeance Low Profile CML16GX3M4A1600C9B
PRICE \$100

16GB of fast memory. Virtualise everything!

VIDEOCARD

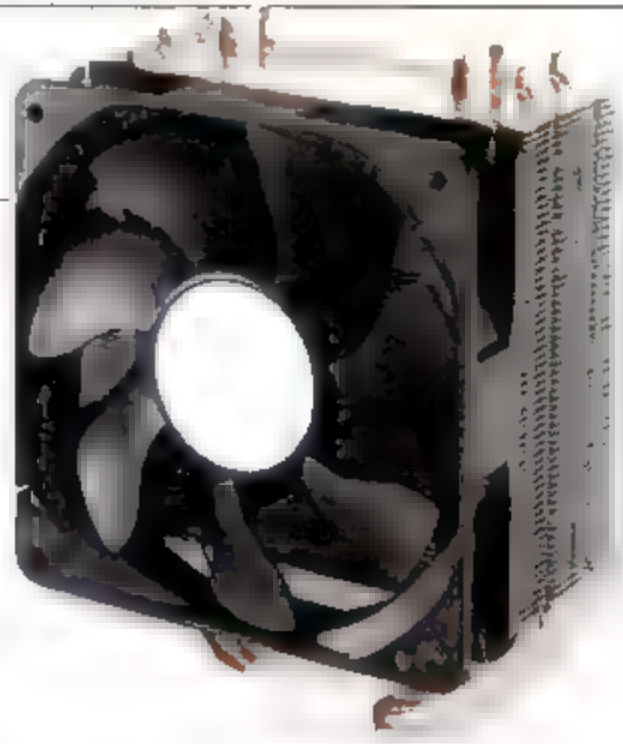
ASUS Matrix Platinum GTX580
PRICE \$750

A beefy single-core card with thermals to match.
Ref ID: 274735



SUBTOTAL: \$1509

RIG ONLY: \$1049

**Coolermaster Hyper 212+**

PRICE \$40

Nice cooling for a very affordable price.

CASE

**Bittfenix Shinobi**

PRICE \$79

Worth it for the price alone, and sexy to boot.
*Ref ID: 260177***2TB HDD**

PRICE \$90

Two thousand gigabyte storage drive on the cheap.

**Pioneer DVR-219L**

PRICE \$35

Discs. You needs 'em.

KEYBOARD

Razer Arctosa

PRICE \$50

A cool-looking keyboard that'll serve you very well.
Ref ID: 149483**Samsung S24A450BW**

PRICE \$260

24 inches of LED backlit, 16:10 LCD screen. Sweet.

MOUSE

**Tt eSports Element Black**

PRICE \$70

Accurate, comfortable and fast.
*Issue 125, Page 39***Plantronics Gamecom 777**

PRICE \$80

Solid set of cans with great audio.
Issue 101, Page 41**Onboard Realtek ALC889A**

A decent chip that does the job.

POWER SUPPLY

Corsair HX-650

PRICE \$150

A solid PSU, ready to power anything you throw at it.



SUBTOTAL: \$5259

RIG ONLY: \$3935

**Noctua NH-D14 CPU Cooler**

PRICE \$95

Bulky, yet quiet and effective. Or skip this entirely and water-cool!
Issue 122, Page 47

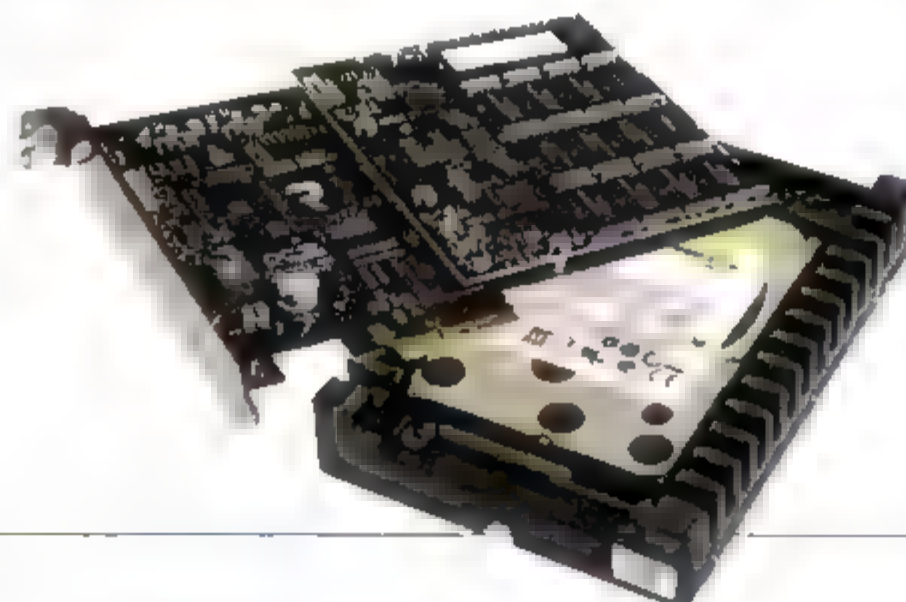
CASE

**SilverStone Temjin TJ11**

PRICE \$600

The best and only case you'll ever need. Premium luxurious bliss.
*Ref ID: 257544***OCZ REvo Drive x2 & WD 600GB VelociRaptor**

PRICE \$580 + \$320

Superfast SSD with zippy storage.
OCZ: Issue 121, Page 43
WD: Ref ID: 220323

KEYBOARD

Razer BlackWidow Ultimate

PRICE \$160

The new benchmark in gaming quality.
Ref ID: 251095**Dell U2410**

PRICE \$699

In-Plane Switching, 1.07 billion colours and 24 inches.

MOUSE

**SteelSeries Sensei**

PRICE \$115

The best-performing mouse we've used to date!
*Ref ID: 276668***ASUS Xonar Xense**

PRICE \$350

Odd package, but the card alone is awesome.
Issue 124, Page 41

POWER SUPPLY

Antec HCP 1200W

PRICE \$320

Plug in a graphics card. Or four. The HCP won't care.
Ref ID: 272588

The **LAN Rig**, the ultimate in portable gaming power – go anywhere, frag anyone. No longer will you be tied to a desk or forced to awkwardly manhandle your full-sized rig, helped by a convenient handle and beefy tech. Perfect for wowing people at LANs, the tech inside is fast enough to run any game, and boasts enough speed to keep your game running at full clip even if other programs intrude in the background. After all, no-one wants to miss a headshot.

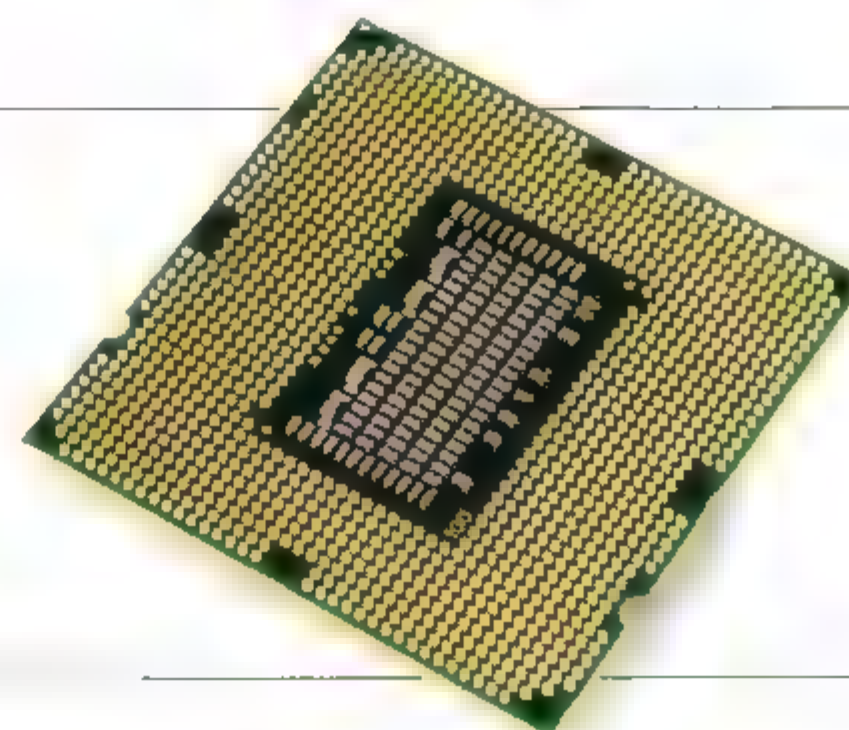
Though November has come and gone it seems we're going to be stuck with the current slew of graphics cards over the Christmas break – past years have seen major shakeups at just this time. But until next year brings around new cards you'll be just as well-served by the GTX560 for most of your gaming needs (so long as you compromise on Anti-Aliasing and resolution).



Finally, for the more entertainment-minded – and really, that's all of us – there's **The Mini**, ready to play movies and music quietly and efficiently. The basic guts are fast enough for general tasks, and the IGP can handle High-Definition content. You can also choose from three entirely optional upgrades to suit your needs best: a graphics card for WoW, TV tuner to catch the game, or a Wireless card to sync without cables. The perfect energy-conscious build.

THE LAN RIG

CPU


Intel Core i5 2310

PRICE \$190

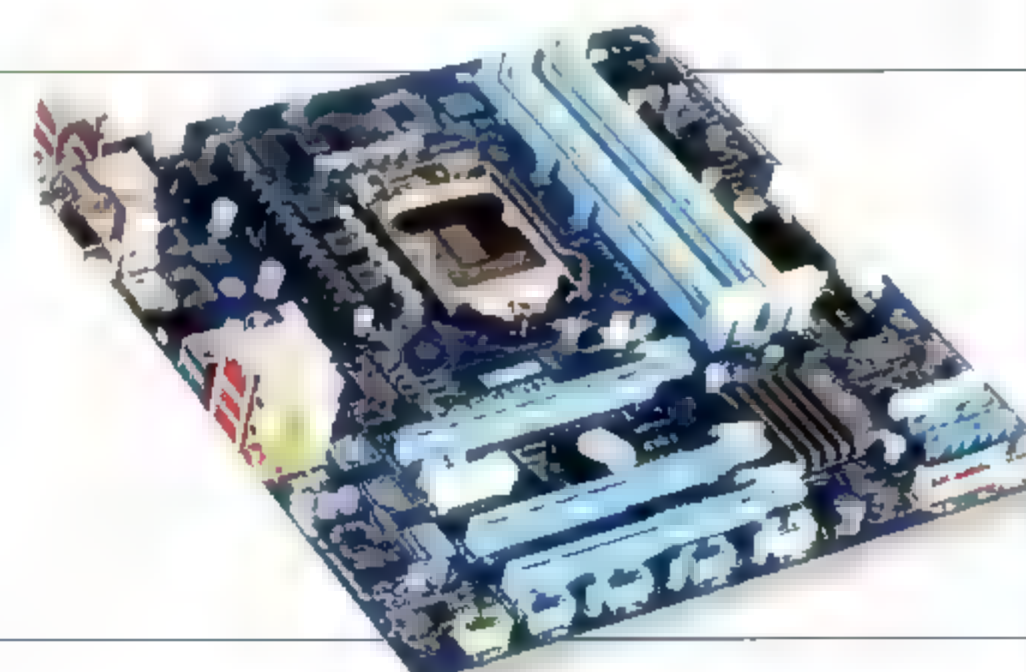
Intel's most affordable quad-core, overclocking limited.

MOTHERBOARD

GIGABYTE Z68MA-D2H-B3

PRICE \$150

A mATX board with everything you need.



MEMORY


G.Skill Ripjaws F3-10666CL7D-4GBRH

PRICE \$45

Great value, tight timings, and some flexibility.

VIDEOCARD

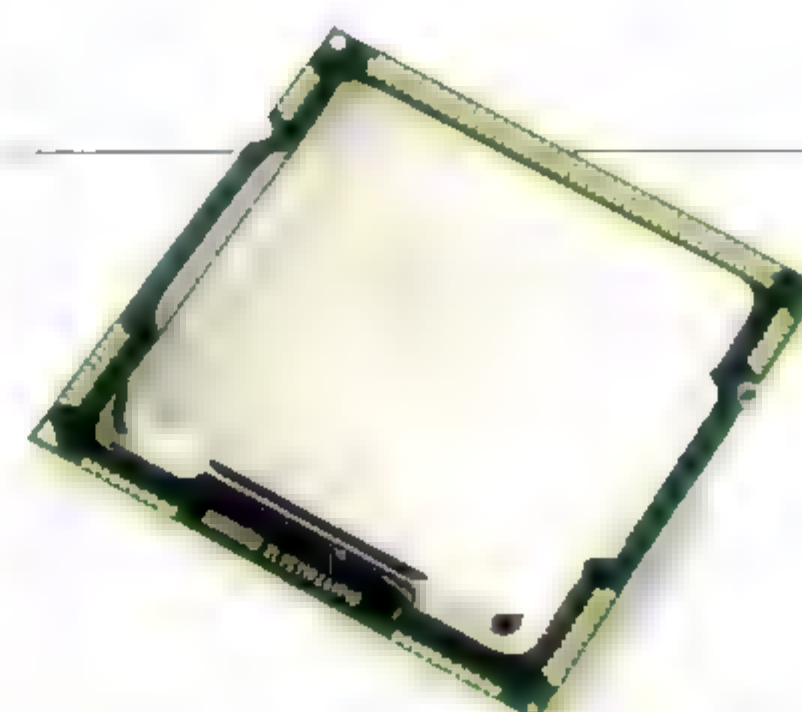
NVIDIA GTX 560

PRICE \$220

A reference-design card, but plenty fast for gaming bliss. *Issue 116, Page 38*


THE MINI

CPU


Intel Core i3 2100T

PRICE \$150

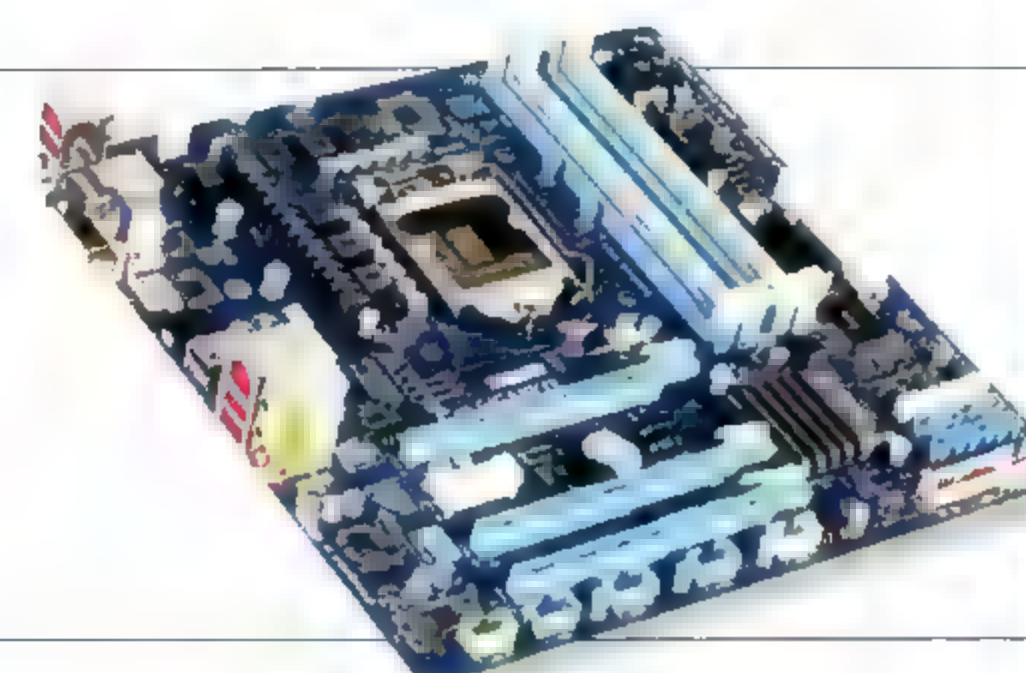
Super low-heat dual-core processor with IGP.

MOTHERBOARD

GIGABYTE Z68MA-D2H-B3

PRICE \$150

A mATX board with plenty of storage options.



MEMORY


G.Skill Ripjaws F3-10666CL7D-4GBRH

PRICE \$55

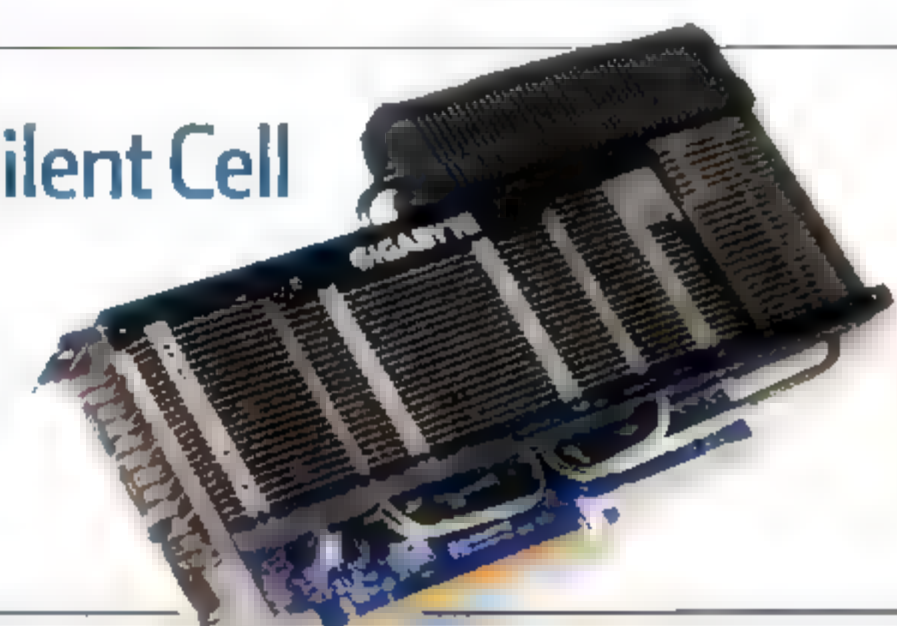
4GB of fast memory is plenty for running multiple HTPC media streaming apps.

VIDEOCARD

Gigabyte HD6770 1GB Silent Cell

PRICE \$145

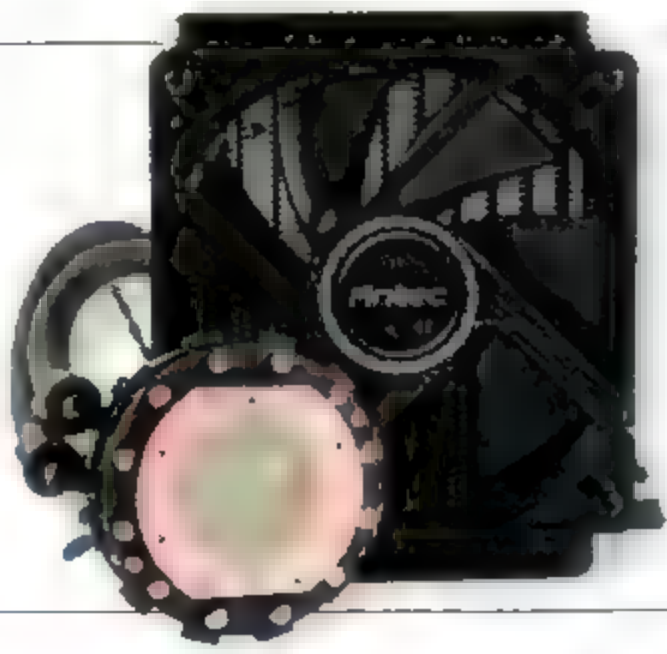
Enough to play games on, and adds outputs without extra noise.



SUBTOTAL: \$1405

RIG ONLY: \$1050

COOLER

**Antec Kuhler 620**

PRICE \$90

Show off your 1337 rig with watercooling. Aw yeah.

CASE

**InWin Dragon Slayer**

PRICE \$80

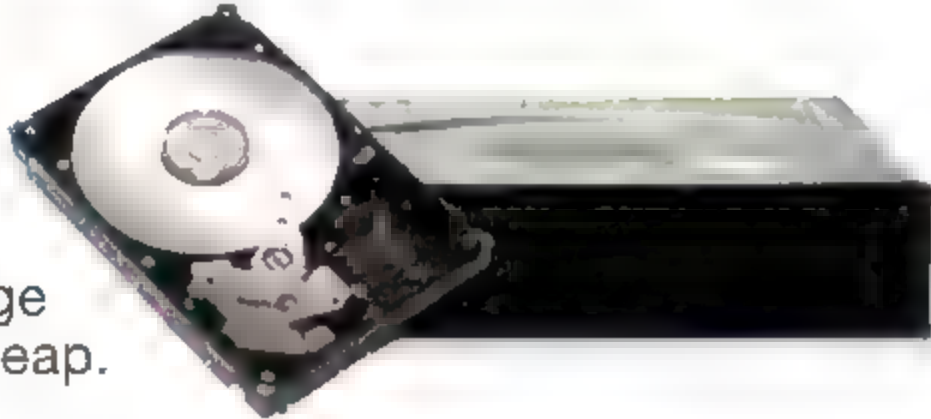
Tiny case with great potential, it's got it where it counts.

SYSTEMDRIVES

2TB HDD

PRICE \$90

Two thousand gigabyte storage drive on the cheap.

**Pioneer DVR-219L**

PRICE \$35

Discs. You needs 'em.

KEYBOARD

Razer Arctosa

PRICE \$50

A cool-looking keyboard that'll serve you very well.
Ref ID: 149483

DISPLAY

**Samsung BX2240**

PRICE \$160

21.5 inches of value-packed screen, great buy.

MOUSE

**Verbatim Rapier V1**

PRICE \$65

Great gaming performance and nifty features.
Issue 96, Page 43

AUDIO

Plantronics Gamecom 777

PRICE \$80

Solid set of cans with great audio.
Issue 101, Page 41**Onboard Realtek ALC889A**

A decent chip that does the job.

POWER SUPPLY

Corsair HX-650

PRICE \$150

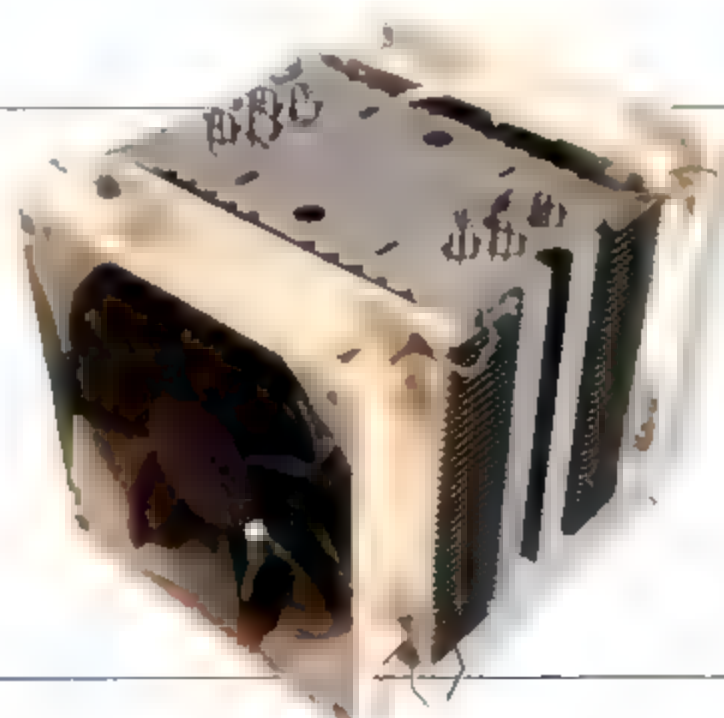
A solid PSU, ready to power anything you throw at it.



SUBTOTAL: \$1455

RIG (NO OPTIONS): \$1070

COOLER

**Noctua NH-U9B SE2**

PRICE \$65

Plenty of cooling, and quietness to boot.

CASE

**Silverstone Fortress FT03**

PRICE \$190

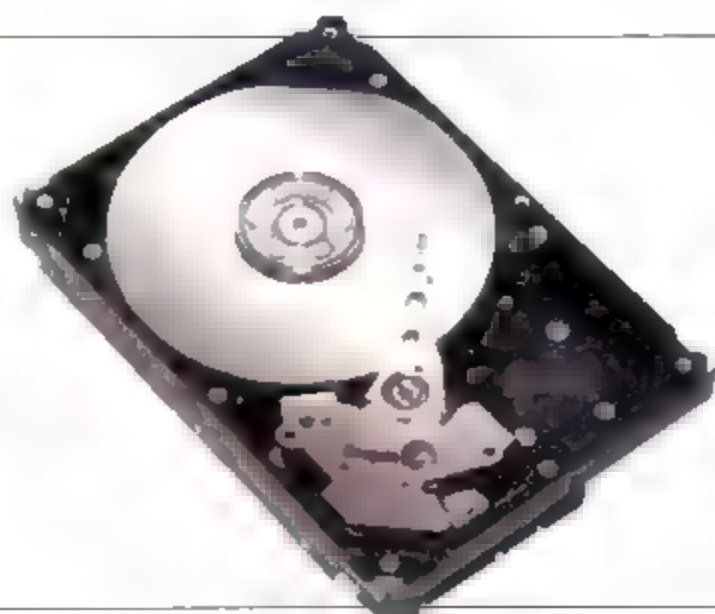
The best HTPC case we've seen yet, with space for plenty o' bits.

SYSTEMDRIVE

2TB HDD

PRICE \$90

Buy three of these for super-crazy storage capacity.



COOLING

Scythe SFF21D

PRICE \$30 x 3

Replace the stock fans and hear the computer no more.



OPTICAL

**Silverstone SOD02B**

PRICE \$80

Slot-loading DVD drive for movies, installs or backups.

KEYBOARD

**Logitech diNovo Edge**

PRICE \$240

Wireless board with a trackpad for mousing.

TVTUNER

Leadtek Winfast PxDVR3200 H

PRICE \$100

Get TV in your PC. H.264 recording ftw!



WIRELESS

ASUS PCE-N13

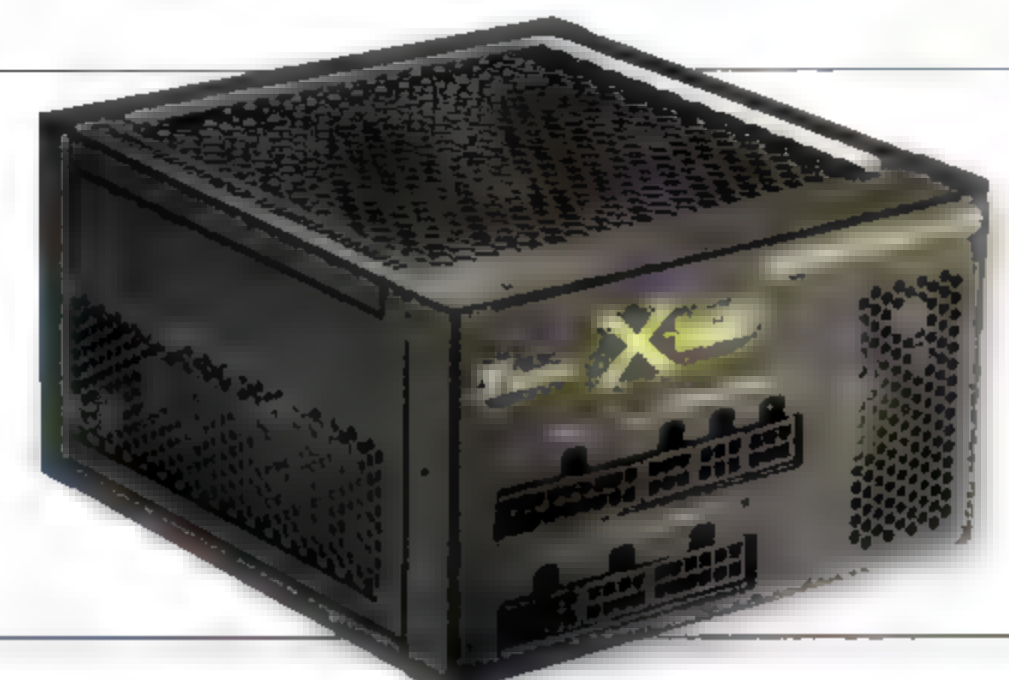
PRICE \$45

Zippy 802.11N for wireless HD video streaming.

POWER SUPPLY

Seasonic X-460 Fanless

PRICE \$200

"Look, ma, no fans!"
-Anonymous, 2011

HEAR EVERYTHING



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Z6A

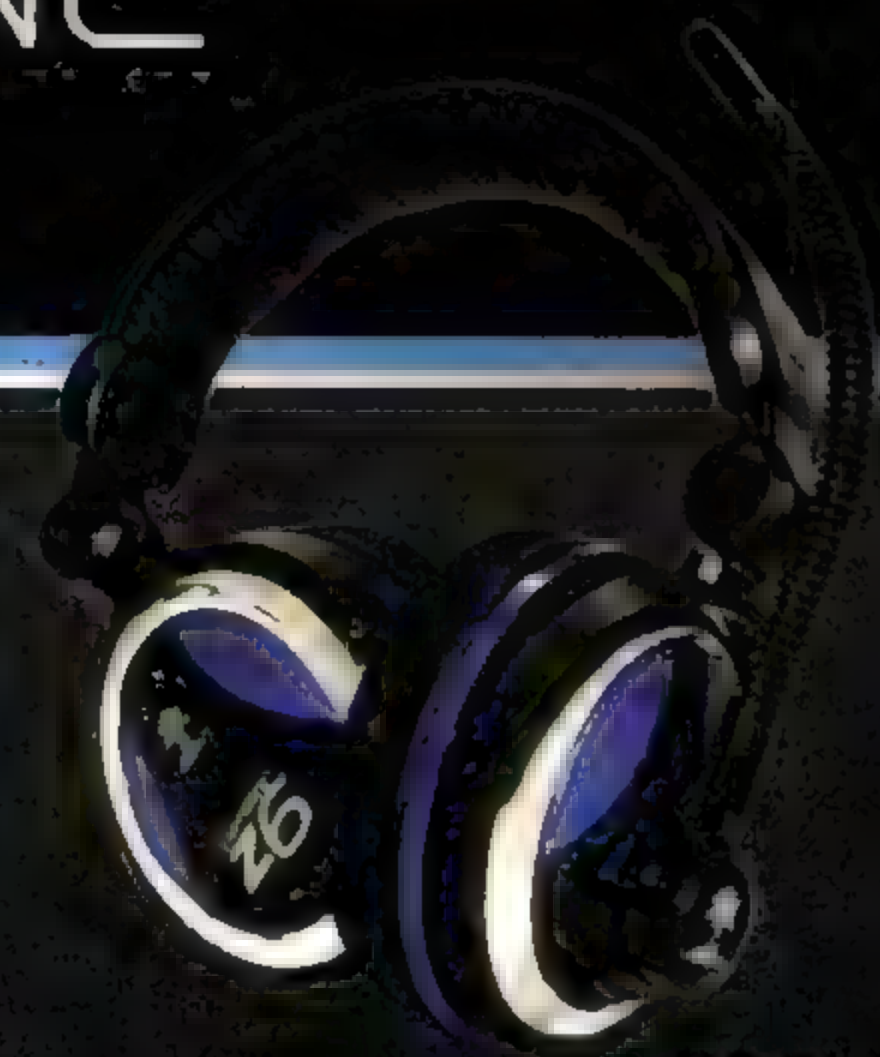
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Put Dan Rutter on the list for HUD-glasses.

What does playing video games do to your mind?

Once you push aside all of the claptrap about games turning 'The Kids Of Today' into murder machines, it's still clear that video games are a novel neural stimulus, and may do something beyond just giving you a tendency to dream about Tetris and imagine health bars above people's heads.

Games have certainly changed my own mental model of the world. In game-land, see, everything is fake.

We're getting closer and closer to true real-world physics in games, but it's still far too computationally expensive to do 3D multi-object

screen. And lag in multiplayer games. And about a thousand other things.

And, of course, actual glitches. Everything on a table in an Oblivion-engine game will gently levitate when you touch one object. Back your car into a swingset in GTA IV and you'll suddenly be catapulted halfway to Vice City. Line up an apocalyptic crash in any number of "serious" racing games and watch your car, miraculously still more or less in one piece, shoot miles into the air, while the one you hit is now wobbling around half-buried in the ground.

This all-pervading fakeness has, I think, seeped into my mind a bit. It goes beyond my newfound thinking that foggy days are how God

that strange world every night, when you dream.

Take hallucinogenic drugs and you can dream, only more so, while you're awake. Play games and you're looking through a window into dream-world, mildly so for "realistic" games, rather more so for *Darwinia*, *Proun*, anything by Jeff Minter, or *Big Rigs: Over the Road Racing*.

And just as *Tetris* can make you see tetrominos in your bathroom tiles and *Eraserhead* can invade your dreams, strange gaming experiences can, and do, affect your perception of the real world.

I'm afraid I have to go, now; the washing's dry, and I have to put it away. The damn drop rate for matching socks can't be better than five per cent. I hope they do something about that in the next patch. *TE*

I'm still vaguely surprised when a thing I left somewhere is still there when I come back...

physics properly (Honourable Mention: *Rigs of Rods*). So games, even "physics games", cheat in numerous ways.

Similarly, raytracing lets computers render perfectly realistic 3D graphics, but raytracing is monstrously processor-intensive too. So today's "realistic" 3D graphics have a huge pile of corner-cutting cheats that sometimes make themselves very apparent. Polygon budget limitations give everything angular edges if you look closely, bump maps make objects seem to have texture until you, uh, look closely, limited texture resolution that makes surfaces blurry when you... let's just say that looking closely is generally discouraged, OK?

Games also keep reminding you that they cheat for all sorts of other reasons. NPCs that are always happy to recite the same spiel every time you talk to them, cars and people that fade into existence just out of your field of view, "urgent" tasks which are only actually urgent if a countdown timer appears in the corner of the

keeps the planet's frame-rate high.

I'm still vaguely surprised when a thing I left somewhere is still there when I come back a week later – shouldn't that container have refreshed by now? I've also lost some faith in solving problems by a process of elimination, not because it doesn't work, but just because when I see a seemingly intractable problem, I suspect it's just a bugged quest that you can't complete until a patch.

I've not yet started being impressed by the universe's attention to detail in, say, putting objects and textures in crawlspaces and canyons where nobody ever goes. But it may only be a matter of time.

I think the world's whole population is actually being primed to adopt this odd worldview, because whether or not you play video games, you've a lot of experience with an alternative reality where objects disappear, physical laws change at random, and people who do things that real people do not actually do. You visit

Dan Rutter's Laundry skill improved by 7 points!

dan@atomicmpc.com.au



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TUTORIAL

HANDS-ON TUTORIALS FOR THE TECHNICALLY MINDED



TUTORIAL CONTENTS

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70

Chris Taylor with sagely advice for those fresh out of high school.

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MAXIMUM POWER COMPUTING

WEEKLY NEWSLETTER

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Atomic isn't restricted to the pages of this magazine, and there's still plenty more to be had online.

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Smashing assignments



Chris Taylor shares some wisdom for students fresh out of High School.

As this issue hits the shelves, some of you will have just completed year 12. Others will have just finished their first year at TAFE or university, and be perhaps a little let down by their results. Bad marks by themselves don't mean you're daft. Conversely, straight high distinctions don't mean you'll graduate to become a great programmer or technician or whatever it is you're hoping to be when you're all grown up like mummy and daddy. And yet... good marks never, ever hurt. Not all, but some employers do look at them. It's frequent enough to be concerned about. Even if they're not looking for high distinction average, a sea of 'P' could be taken as a sign that you often fart around. Furthermore, if you're intending to stick around campus for a while – you want further qualifications, you like the self-importance and placard waving and, er, physically generous art students associated student politics – then good marks can help with that, as well as programs offered to a select few (i.e. special internships). In short, it never hurts to spend a few more hours pining for Skyrim's fjords and going over that database assignment a couple more times. At the same time, there's more to academic success than ploughing hours and hours into reading and rereading the assigned textbooks and adopting a regime of 20-hour, caffeine-powered days in the lead up to the exam period. Effective study is about working efficiently.

Preparing for assignments and exams

Maybe the best resource for doing well in assignments and exams – aside from, you know, actually knowing the subject matter because you've read whatever you were told to read and attended the classes you were supposed to attend – are the assignments and exams themselves. Most lecturers are decent enough to provide fairly detailed feedback. The feedback is more important than the percentage or the letter grade. The feedback is there to prevent you from making the same mistakes again and again. If you're constantly being docked points for poor spelling, grammatical errors or illogically structuring your ideas, then maybe you need to read your own work several times before submitting it, ask friends (preferably ones who are competent wordsmiths themselves) to proofread your work and provide honest criticism or – if it's truly tragic – enrol in one of the university's short courses on academic writing. If referencing lets you down, again, the academic writing course might be a good option. Or have a poke around on Google for a nice, extensive

.pdf guide on whatever style of referencing your faculty prefers. The little details – muddling up the order in which you're meant to acknowledge the author's name, the title and the place of publication (making it sound like you helped your uncle jack off a horse as opposed to helping Uncle Jack off a horse) – are significant. God and the Devil, too, reside therein.

Look also at the subjects you tend to succeed at. If you're racking up distinctions in your programming-type courses, you don't really need to focus on them so much – although that's not say you should slack off. Conversely, if you're consistently getting credits and passes in the 'soft' subjects (communication-type stuff, business and law-related units) then you need to double your efforts in those areas. If you've got a limited amount of time in which to study, these areas should be your focus. This is good time management in action.

Be a bookworm

It also doesn't hurt to read more widely than the list of suggested texts. In any assignment where the lecturer provides a list of books or papers that he thinks are just swell, it's a fair bet that he wants you to refer to at least some of them in your assignment. Dismiss the list of recommended books at your peril. A list of suggested texts is only a starting point, however. Look at the books and papers the suggested ones refer to. Poke around the library or the university's collection of electronic readings to see if you can find something interesting. Referring to a couple of resources you've found on your own never hurts... particularly if one of those resources was penned by your lecturer.

Obviously, showing up to class is significant. As much as everything – audio recordings, slideshows, handouts – should be online these days, quite often it's not. And even if those resources are there, things that the lecturer or tutor mentioned offhandedly probably won't be. Attending class and staying at least vaguely attentive in class, rather dozing or playing Angry Birds or talking about irrelevancies, means you wind up with notes on which to draw upon during assignments and exams. Lecturers tend to drop hints about the material that's going to be assessed or things they really like or dislike. Keep in mind that note-taking is a skill. Good note-taking is more than producing hand-written versions of the lecturer's artfully Clip-Arted PowerPoint slides. It's about ensuring that weeks or months down the track – whenever you get the assignment, whenever you're preparing for the exam – you remember the important material. Some vague

dot point in chicken scratch handwriting won't stand the test of time, even though it might make sense to you now.

Organise your notes in some way, whether they're electronic or handwritten. Sort by date or, ideally, topic. A huge wad of scrunched up papers or a My Documents directory organised as if by digital tornado might contain useful information, but you're going to have to waste time sifting through the dirt to find the gold.

Subject websites, as well as library websites, can have useful resources tucked away. Old exams and assignment papers, circa a year or two ago (don't go back too far – the syllabus has probably changed significantly), most likely aren't that different from what you're going to get this year. Over such a short period of time, it's doubtful they've radically modified the format. It's likely that there will be a common theme running through the questions, even if the questions themselves differ from year to year. If you look at 2010's exam and think "damn, I couldn't do this", then you need to get your act together



before you find yourself thinking the exact same thoughts when sitting on a numbered table in a stuffy hall in front of 2012's paper.

Answer the questions

There's a significant skill in reading and comprehending assignment and exam questions. You might write a brilliant piece of academic prose, but it's all for nothing if you don't actually answer the question. If the question is vague – and that's not uncommon – then seek clarification from the lecturer before writing anything. In exams that's not an option,

homemade 'cheat sheets' – into an exam then do so, although don't assume that 'open book' is a homonym for 'open the book for the first time during the exam.' Nice touches are noting down the names of theorists or academics you've read during the course of the unit – particularly if they're writers the lecturer agrees with – so you can reference them in your responses to exam questions. It's probably not expected, but going a little above and beyond doesn't hurt.

Don't spend the entirety of the time writing, either. Only freaks can produce artfully written



trailing off like one of those movies that abruptly ends just as things start to get interesting.

Finally, whether you're in an exam or about to commence an assignment, develop a clear understanding of what the assessor's expectations are. Assignment briefs often include a rubric, a detailed breakdown of how many marks are allocated to each component of the assignment (a good rubric should explicitly talk about how HD-level referencing looks like this, D-level referencing looks like that, C-level referencing looks like this, etc). Exam papers usually tell you how many marks are dedicated to each section or question. This information is useful in determining how much time and effort you should dedicate to each component of the exam or, in the case of an assignment, what percentage of the x-thousand words you should allocate to a specific point. (E)

If you take a look at 2010's exam and think "damn, I couldn't do this", then you need to get your act together

and you're going to have to settle for re-reading the question several times. Ensure you read the instructions, too. Sure, there's the usual waffle about how it's really naughty to copy someone else's work, but tucked away among all the formalities there might be useful information about how you should approach the questions or how you could allocate the two hours of exam time most efficiently. If you're allowed to bring any resources – calculators, textbooks,

papers on their first attempt. Dedicate a little bit of time at the start to planning – jotting down dot points about what you'd like to actually say, so you don't wind up sounding like a rambling Hunter S Thompson meditating on web design. Leave some time at the end for editing and revising – go back and fix up the spelling mistakes and correct the grammatical errors, ensure that you've said everything you set out to say, check that the essay concludes rather than



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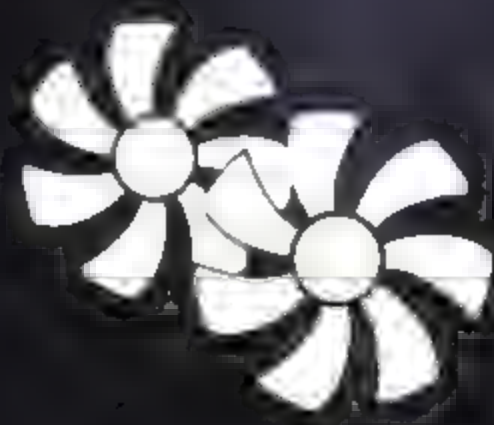
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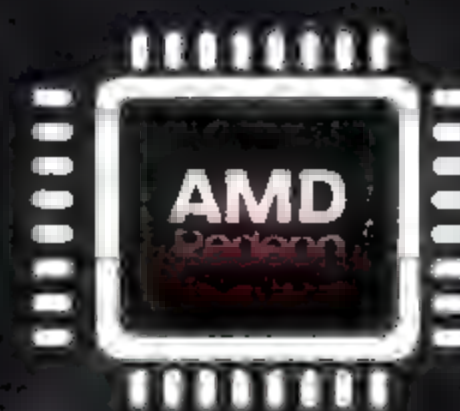


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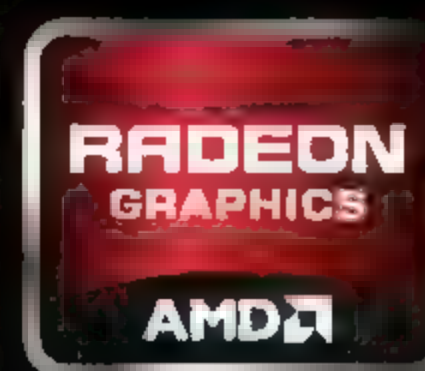
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GAMEPLAY

GAMES, GAMING AND GEEKERY COVERED... ATOMIC-STYLE

It's that time of year again, where we (and a few sponsors) poll Atomicans for their favourite games of the whole year! There's a huge amount of gaming content this month, which feels appropriate considering the huge volume of fantastic games released in time for Christmas – Santa's just around the corner, about to maphack and teabag you (then give you one of the GotY 2011 games 'cos he's nice like that).

We're also rounding out the review section with our usual array of games, including a city-building adventure in the year 2070, some pimp-tastic fun in Saints Row 3, a stabby look at Assassins' Creed Revelations, pwning nublets in CoD: MW3, and adventuring in LotR: WitN. It's a great way to round out the gaming year, and an even better way to ring in 2012! Bring on the new year!

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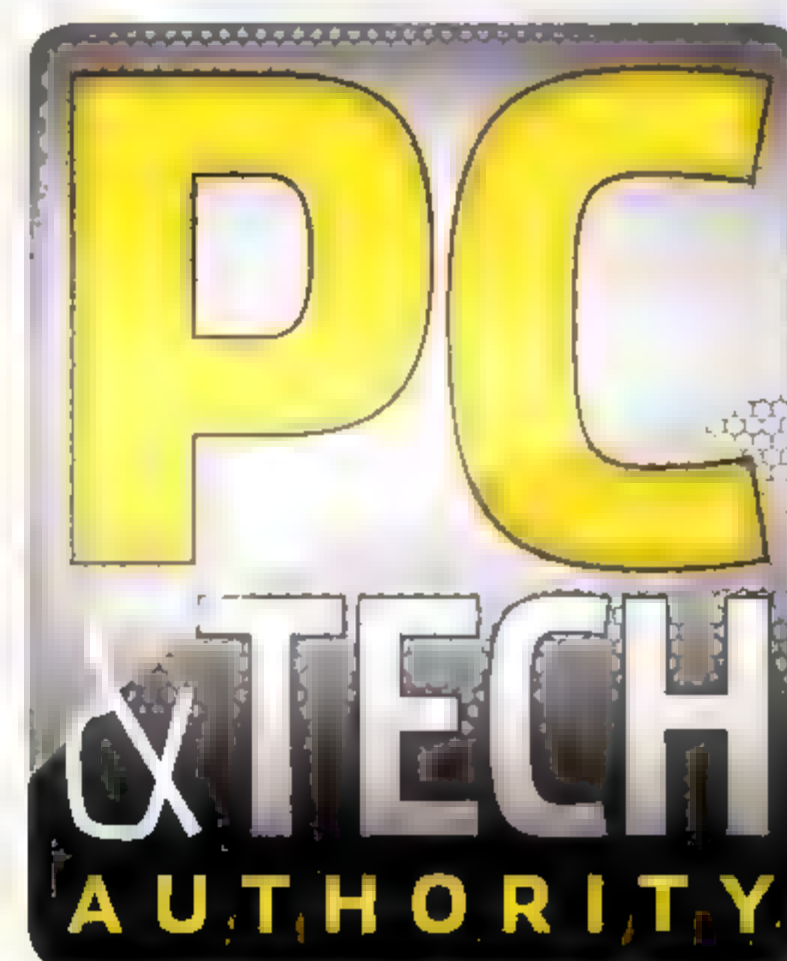
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atomic & GAME OF THE YEAR AWARDS



The best FPS, the tightest strategy game, the most epic RPG. **David Hollingworth** finds out what Atomicians rated as best of the best in the last 12 months.

As is usual for this time of year, gaming is taking over everything in our lives. As gamers we're taking leave, ignoring our pets, hoping our partners will get into their own time-sucking hobbies, and generally dropping any social engagement that doesn't come with its own chat channel and vote-to-kick options.

But it's important to remember that we've had a whole year of great games behind us. Shooters, RPGs, racing games and more have been distracting us all year. Sure, maybe not as much as Skyrim, but there've certainly been a few gems.

So that's why we're here. We polled one of the most enthusiastic and dedicated gaming communities on the planet – YOU – and now we've done the

math, run the numbers and come up with a pretty good idea of what's really floated your gaming boat in 2011 (and a bit of 2010). We're going to break down FPS, action/RPG games, MMOs, strategy and racing games, as well as messing about with some older more classic games, to find out what games dominate each genre. On top of that, we're going to find out our top three: the three games that above all others have impressed Atomicians more than anything else.

But before we get too deep into things, we want to give a shout-out to our sponsors for this year's Game of the Year Awards, without whom we would not be able to dedicate the time to calculating and tallying all the votes. So, GIGABYTE and Kingston, thank for your support! Now...

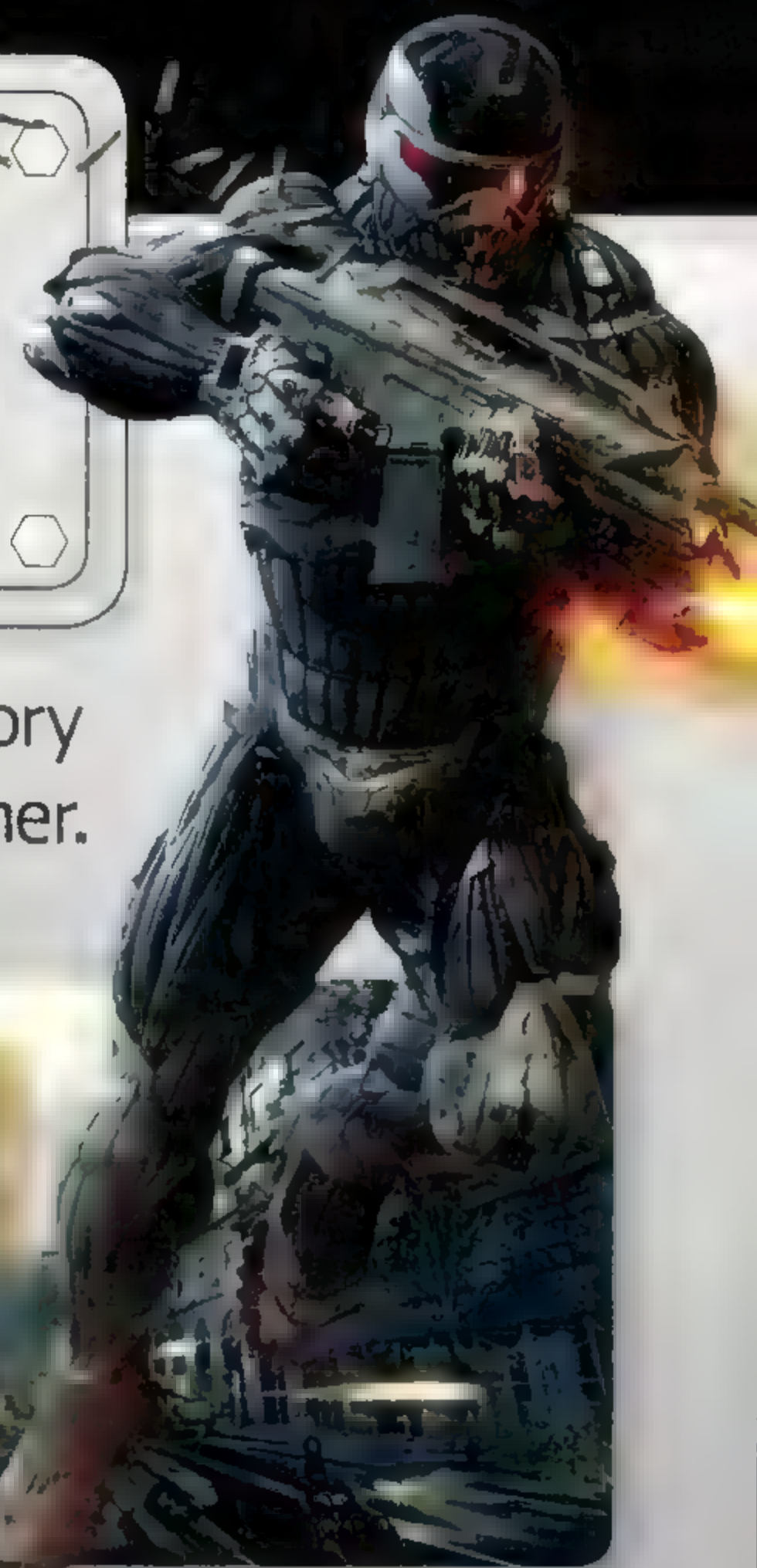
GAME ON!





GAME OF THE YEAR AWARDS

FIRST/THIRD PERSON SHOOTER



Still the favourite Atomican way to kill a few hours (and friends), the two-category shooter round-up this year was hard fought... but with a nonetheless clear winner.

In a lot of ways, the Atomic readership are staunch traditionalists. They like their games on PC, and preferably with a lot of guns, and even more preferably-er (that's a word now [Suuuure it is -Dep Ed]) with them in control of said guns.

In other words, you guys really like shooters, especially of the FPS variety.

And hey, who are we to judge. We've sunk a lot of time into pretty much all of these winning games, and some of them will likely continue to be our major source of stress-control when the forums go nuts, or

deadline's approaching. There's just something about the ability to take control in a shooter, personal control, and pretend for a moment that you're not a wage-slave/student/experimental substance tester – and instead are an elegant killing machine.

Probably not what the polities in control of an R18 rating want to hear, though...

5. CRYSIS 2

www.atomicmpc.com.au/?258277

The bottom of our list was remarkably close, with Crysis 2 and Portal 2 tying for fifth throughout most of the voting period. In the end, though, Portal received more primary votes, so gets the nod as the more popular game. As to Crysis 2... Well, we weren't all that convinced at launch, to be honest, but once the DX11 and texture patch came out, the game certainly did start to approach the system-freezing beauty of the original. At the end of the day though, the game did suffer from the need to make a shooter that could stream smoothly down the rather middling pipes of a console; compared to the original, it was a much more linear, focused affair.

On the bright side, that focus did lead to a lot of small, yet finely-tuned enemy encounters. Whereas fights in the original were sprawling and open, even across miles of jungle, these were more intimate, more handcrafted.

In all honesty, in terms of making sure the game could be as good as possible on PC, despite its console roots, Crytek didn't do too bad. It didn't do not too bad at all indeed.

4. PORTAL 2

www.atomicmpc.com.au/?261108

Much like last year, we have a couple of games that have made it into top spots across a couple of genres. Many polls like this would ignore that kind of cross-over, but at Atomic, we celebrate it, because it often means a game is a breakaway hit, and with such a wide audience it deserves the



multi-kill of multiple accolades.

And that pretty much describes Portal 2, one of the most compact and perfectly-formed games you'll ever play. It is the perfect closed room drama, with you cast as the hero just trying to get out – in fact, you're the only human in the game. And you only have one gun. And, technically, it doesn't 'shoot'.

But that's the beauty of it. In the framework of the classic first person, down the barrel shooter, Portal 2 manages to tell not only a wonderful story, but also one that's possibly the funniest we've listened to this year. If you're the kind of gamer to rush through each puzzle in your efforts to escape, you're missing the point of Portal – take your time, treat each puzzle as a test, one that will grant the reward of the best dialogue and voicework in any game, hands down.

Cave Johnson definitely approves.

3. DEUS EX: HUMAN REVOLUTION

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Here's another game that handily straddles two gaming worlds; much like Fallout: New Vegas managed last year, and for much the same reasons. Yes, Deus Ex: Human Revolution is really an RPG, yes, it's all about choice and drama, and generally angsty your way across the planet. Yes. (Double-yes -Dep Ed) But it's also a seriously kick-arse shooter, with a lot of engaging mechanics, the kind that you can only get when you combine sharp combat with RPG depth.

In fact, it's almost become its own genre, one that BioWare – who know a thing or two about fusing those – call an RPS, or roleplaying shooter.

The great thing about DX:HR is, if you want, you can ignore combat almost entirely – those are the guys who probably voted for it over in the RPG roundup. But if you take the 'guns solve all problems' route, like we did, then you're in for a lot of fun. Great weapons, complete with great upgrades, a tonne of almost literally too-much-

WHAT YOU SAID

Battlefield 3

"Superb graphics and totally awesome gameplay! Best FPS ever!!!"

S. Barsby

"I have been a DICE fan since Codename Eagle and the realism in latest battlefield in amazing."

D. Barrett

Modern Warfare 3

"It is so engrossing & addictive. It gets better in every new edition"

A. Brown

DX:HR

"Deus Ex has it all and is very reminiscent of the original which I loved. A great game to play through."

S. Emanon

Portal 2

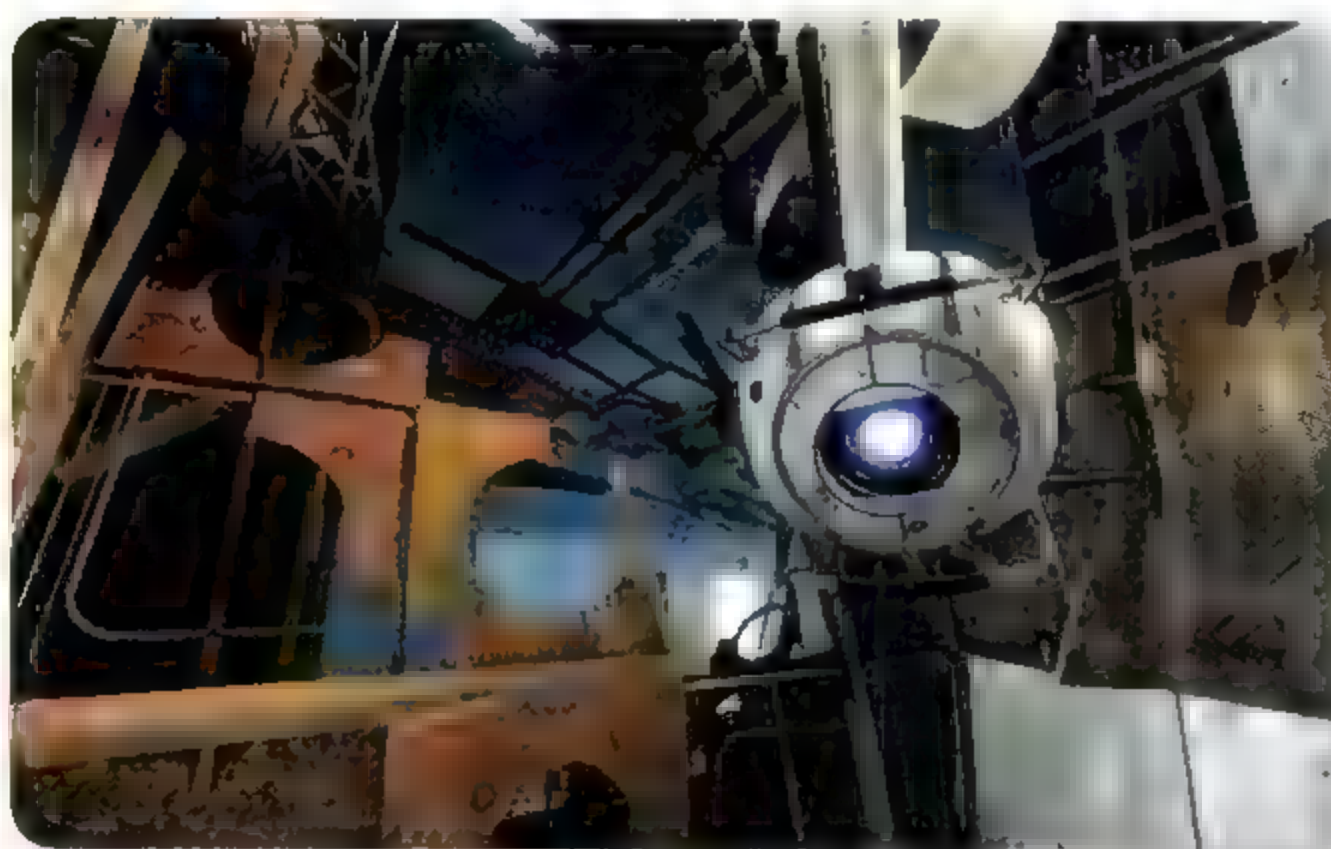
"Ok, if I need to explain this... well....I've lost faith in humanity."

C. Perri

Crysis 2

"Great gameplay, good replay value, dx11 upgrade impressed."

Anon.



fun cybernetic upgrades, and some stealth-based takedowns that switch to third person to show off some graceful kills (or merely bone-snapping, if you're that way inclined). It's a slick production across the board.

2. MODERN WARFARE 3

www.atomicmpc.com.au/?271847

Love it or hate it – we're gonna stay out of this argument – there's no escaping the 800-tonne gorilla in the mist that is the Call of Duty franchise, which not only comes in second in this roundup, but is the second most popular game, period. Wow.

We could (and often do, if you get a beer or two into us) go on about how sales do not

equal quality, and how appealing to the lowest common denominator of gaming is an easy win, but there's also no denying that Infinity Ward and its publisher, Activision, really know what they're doing when it comes delivering a cinematic action experience.

That goes double for Modern Warfare's multiplayer. The game may not break any moulds, but it shows an understanding of the ebb and flow of high-octane PvP; it's pretty compelling. It may lack the depth of our FPS winner, but Modern Warfare 3 is one of those rare games that can deliver a satisfying multiplayer experience in short bursts of adrenaline and gunfire, time after time.

And that deserves respect.



We recently got torn a new one by some on the forums for liking this one, as some players are having some issues. Which, we admit, really sucks. However, enough players must be having the same awesome time we are because not only is Battlefield 3 our runaway top FPS by a HUGE margin, it's also our Game of the Year overall winner. More Atomicans voted this as their number one game than any other, and we really don't blame them.

Sure, the singleplayer is a bit of a letdown, but who buys a Battlefield game for that? You buy it for true mixed-arms warfare – infantry laying

down covering fire as a squad exits an APC, as tanks roll ahead to break up the enemy defence. Jets stream overhead fighting for air superiority as enemy choppers go armour hunting... and in BF3, we even get superior destruction – not to mention the best looking game on PC this year – thanks to the fantastic FrostBite2 engine.

DICE is already showing it intends to look after the game, too, with some solid patches coming in the next few months, so we're expecting BF3 to be a part of our gaming lives for years to come.

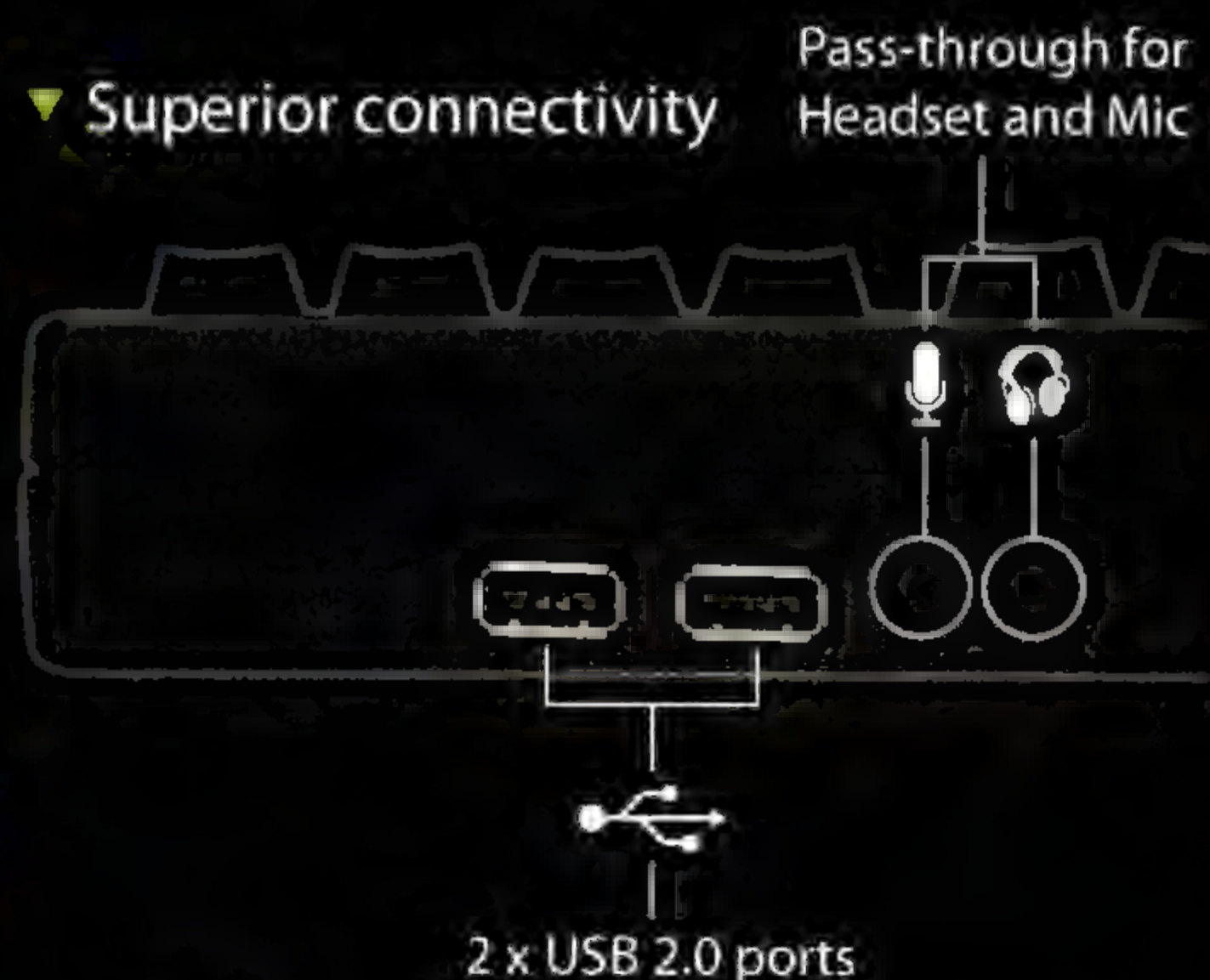
It's like coming home; but with more guns.



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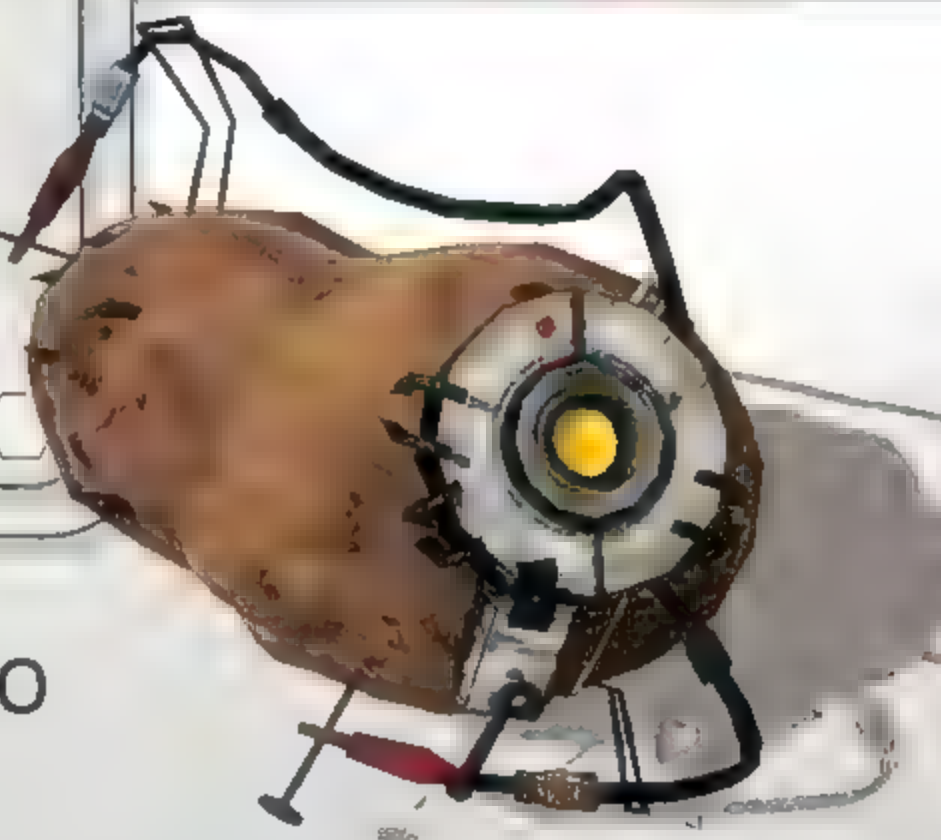
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GAME OF THE YEAR AWARDS

TURN-BASED/REAL-TIME STRATEGY



Without a StarCraft release this year we get a much flatter playing field – so who manages to outflank the opposition and come out on top?

If it's not violence on the micro-scale that Atomicans love, it's violence (or, at the least, strategic conflict) on a macro-scale. In other words: strategy games.

StarCraft 2 unsurprisingly dominated the poll last year, and with good reason. It pretty much delivered on everything it promised, and while it wasn't perfect (for one thing, it really didn't look like a super-modern game), it certainly showed that Blizzard had not missed a beat when it came to basic RTS game design.

This year the field is much more open. We've gotten mightily addicted to a few of this year's strategy titles, but perhaps

not quite as much as in years past. In fact, the strategy title we've actually played the most is Napoleon: Total War, rather than Shogun 2. But what have YOU been playing?

5. MIGHT AND MAGIC VI: HEROES

www.atomicmpc.com.au/?276521

Curious name-change aside, HOMM (as it'll be known to most) delivered pretty much what its fans were hoping for. It has exploration, a range of factions to play, swarthy knights, and of course the time-honoured (though, to our mind, rather ancient and slow) turn-based, action-point-powered combat.

It's very much a matter of horses for courses, and there were some fans who felt the game was a departure from previous efforts. In the game's defence, though – which, given it's made the top five, it likely doesn't need – it showed that developer Black Hole Studios were willing to push the game a little into different areas, and those changes certainly did ring true with those who liked the game.

It was a good example of a developer not trying to please everyone, which is rather rare in gaming these days.

4. PORTAL 2

www.atomicmpc.com.au/?261108

Uh... what?

Actually, if you step back for a minute and ignore the fact that Portal 2 is a first person game, you'll realise that the core of the title is not shooting, but rather the careful arrangement of

often limited resources to solve a number of set challenges in whatever way you see fit.

In other words, it's very nearly pure strategy, just from a different, unintuitive – and often hilarious – perspective.

Portal manages that wonderful trick of eliciting incredible complexity from just a handful of ingredients, which is the heart of most classic strategy games. It really deserves that 'takes moments to learn, years to master' label that many strategy board games get. At the start of each level, you usually have every component you're going to need, and a clear idea of the end goal of each puzzle, but beyond that... the strategy of how you approach the game is pretty open.

Plus, you know... it's Portal! Do you want to disappoint Cave Johnson by NOT letting it appear in two categories? (*I know I certainly don't!* –Dep Ed)

3. AGE OF EMPIRES ONLINE

www.atomicmpc.com.au/?259467

We hate to admit this, but we've really not had much to do with this one. In fact...we've not even played it!

In our ongoing quest to continually divide and sub-divide the planet's population into two halves, we believe there are two kinds of strategy gamer – those who dig the rock-scissors-paper perfection of Age of Empires and its ilk, and, well, those like me, who rather more open fare.

But one thing we can recognise about Age of Empires Online is that it's a bold move for the venerable franchise, one that seems to have really worked. The cartoony style of the game seems to owe more to classic civ-games of the



WHAT YOU SAID

Shogun 2: Total War

"Endless strategic and tactical choices with extremely frantic yet cinematic battle sequences."

L. Robb

"Did any other strategy games even come out?"

E. Fay

DoWII: Retribution

"Always loved the Warhammer 40k universe and the game lives up to the setting."

M. Middleton

Age of Empires Online

"Another continuation of the legacy of a classic series, with delightful new twist and atmosphere."

Y. Li

Portal 2

"Just an awesome game with great humor and fun puzzles."

Y. Viljoen

HOMMVI

"Old school strat is back!"

G. Tomlinson



past, but it's struck a chord with a wider and more dedicated audience. Even our own John Gillooly has tested the waters of AoEO (which, if you say it out loud, sounds more like a yodel than a game) and pronounced them to be good. So, hey – what do we know?

2. DAWN OF WAR II: RETRIBUTION

www.atomicmpc.com.au/?258642

Now, here's a game we know, and one that, frankly, just keeps impressing us.

For the second year running a DoWII expansion – not the main game, mind – has

made the top five; that's got to be some rare and unique form of high praise, that even the add-ons for Relic's excellent Warhammer 40,000 strategy titles can compete fairly and squarely with complete releases from other companies.

Part of the success of these games is that they are standalone, which just makes them very generous – they can be played without the original, even down to multiplayer. The other part, though, is that Relic just gets the 40k universe. Retribution may not be the best DoW title ever released, but it's certainly a solid addition to the series and well worthy of making the cut in 2011's top five.

1 SHOGUN 2: TOTAL WAR

www.atomicmpc.com.au/?257737

It may not be as clear a winner as Battlefield 3, but it's illuminating that Shogun 2 got nearly double the votes of its nearest competitor.

And really... is anyone surprised?

Creative Assembly has been fine-tuning its brand of strategy ever since the first, eye-popping Shogun. Back then, it was all blurry landscape textures and 2D sprites, so going back to the feudal Japanese setting with a new engine – that got even better when the DX11 patch came out – made sense not only to the devs, but to gamers as well. And wow, did the game deliver.

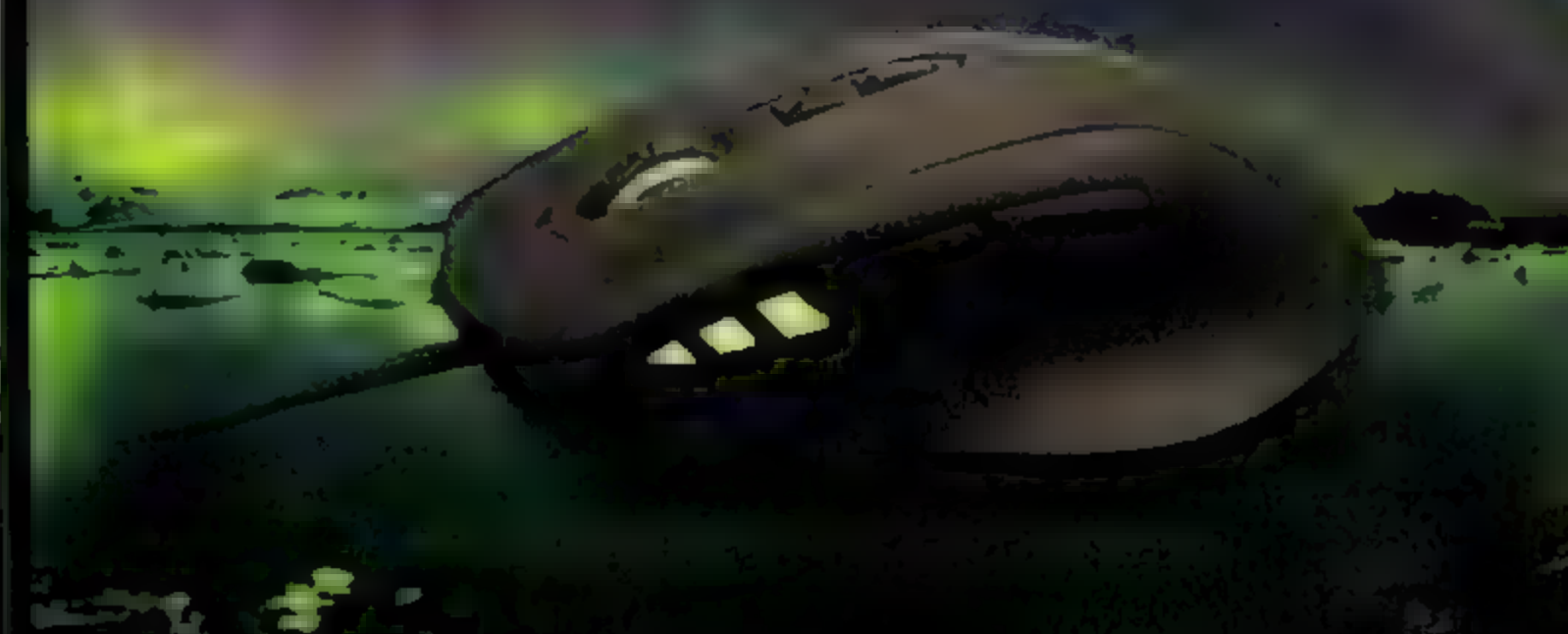
It looked beautiful, of course, but also delivered untold of depth in the series. From the way you could tailor the skills and abilities of your generals and Clan, to the non-combat units you could employ, even to the way religion played a role in the game... it was a bravura effort.

Now with this under their belt, and the third most popular game this year, maybe Creative Assembly will listen to our begging demands that their next title be about the American Civil War... please?!



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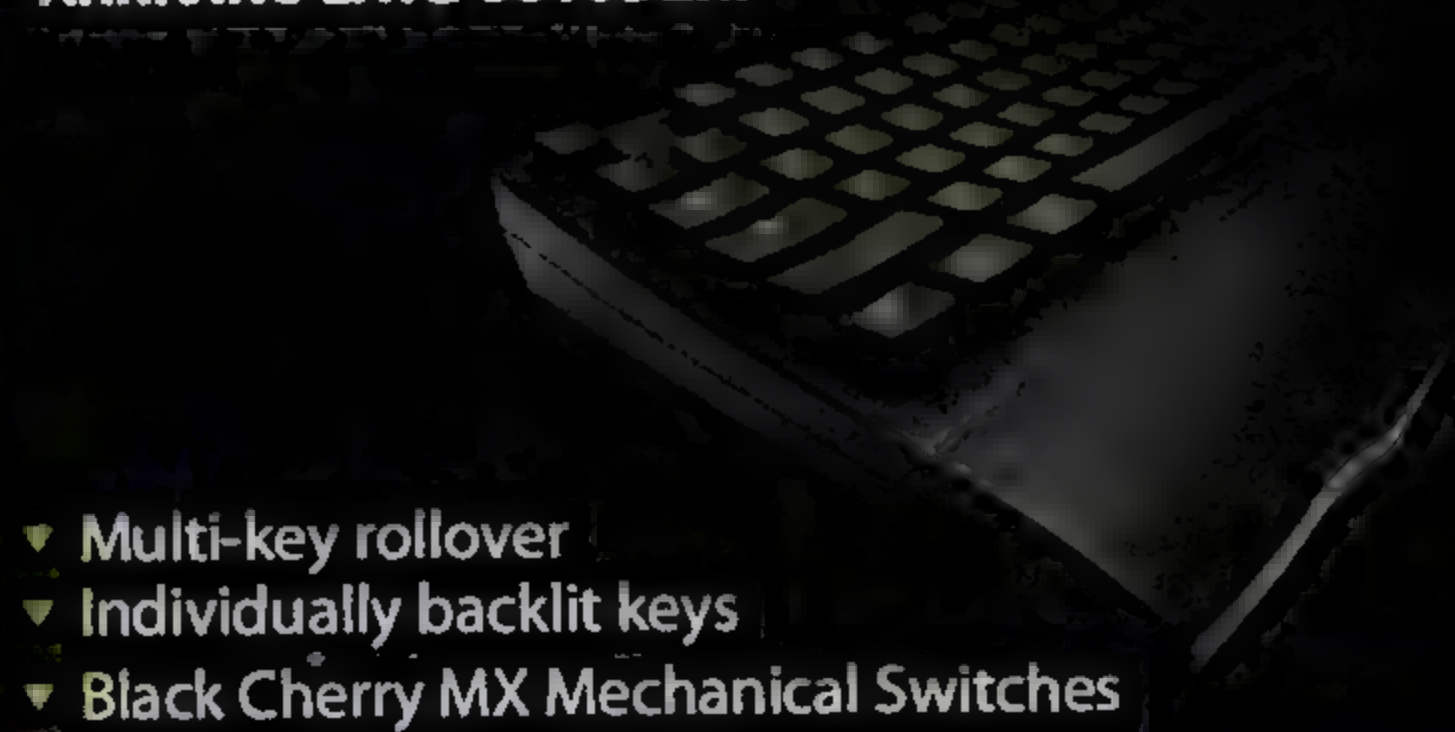


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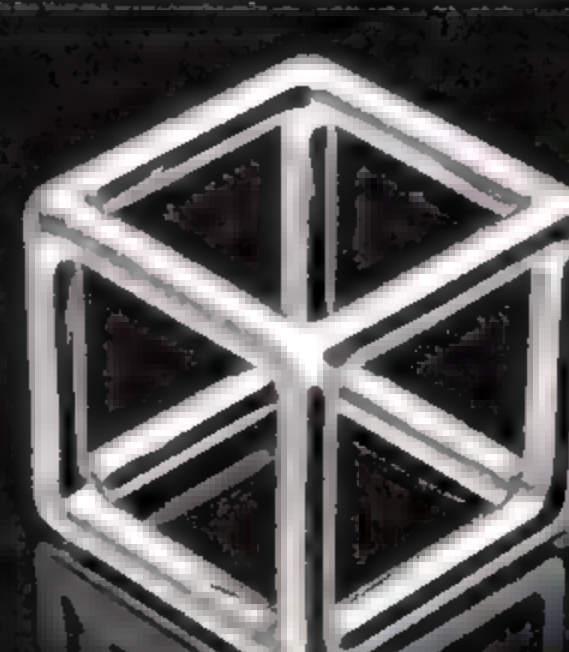
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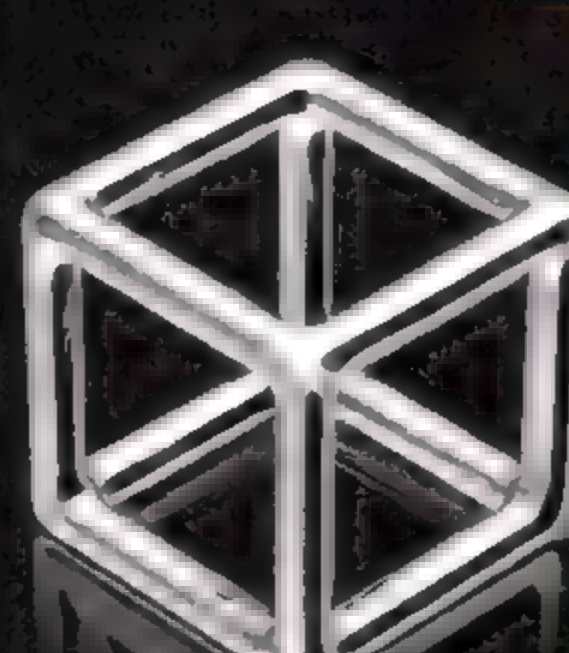
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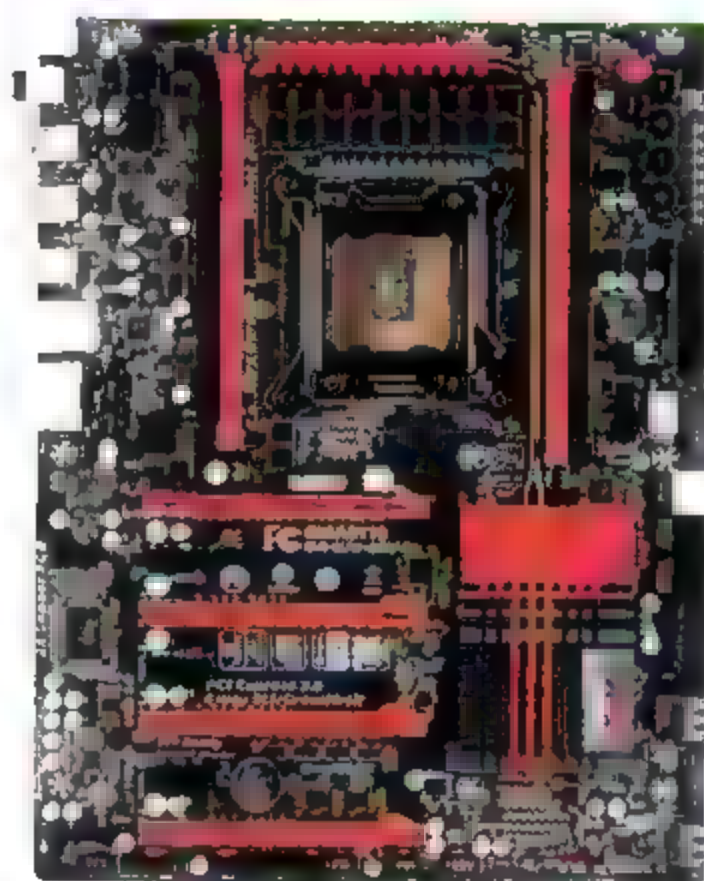


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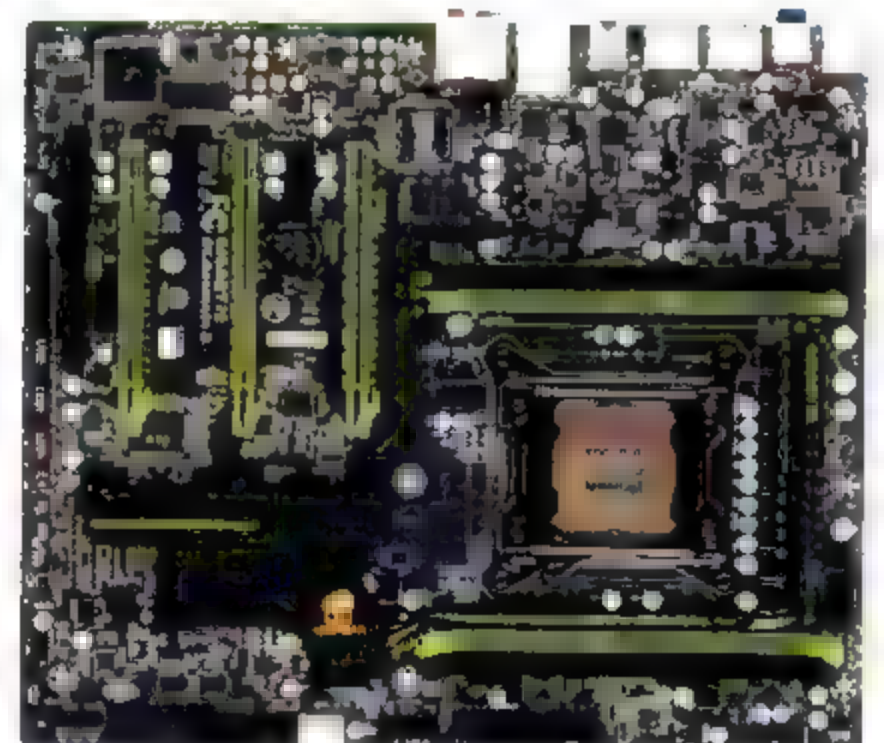
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Gen. 3

4 channel
DDR3

*3D BIOS and the 3D Power utility are available for download from the official GIGABYTE website.

GAME OF THE YEAR AWARDS

MASSIVELY
MULTIPLAYER

The number one stays number one, but the rest of the pack has totally changed – competition's finally heating up!

As we did last year, we're casting the net a little wider when it comes to MMOs. These games are a special case, with a shelf-life long beyond that of other, less communal titles. World of Warcraft carried out the top spot last year despite being years old, holding off newer, fresher competitors with style and verve.

But that's the catchcall of a heavy-hitter in this genre. A game that can retain fans, or claw in new players, will dominate the space, and that's pretty much what Blizzard's giant currency bovine is doing quite handily. In fact, it's probably not much of a spoiler to say it's done very well again, but the pack behind it... that's very interesting this year.

5. STAR WARS: THE OLD REPUBLIC

www.atomicmpc.com.au/?235220

You know a game's pretty hyped when it manages to make a list like this without even being released. But that's what you get with SWTOR, which has not only the whole Star Wars cadre's buzz behind it, but also the cache of undeniable cool that comes from it being BioWare's first foray into the MMO

market. The game is in beta, after all, and some of our voters have played it.

The really interesting thing is that there's no local release date for this game yet – you can order it overseas, and play it on American servers, but it's not officially supported in our chunk of globe. But the draw of the game is quickly becoming irresistible. With BioWare's history of excellent games like Mass Effect and Knights of the Old Republic combined with what's looking like a cunning use of standard MMO mechanics (read: WoW), and of course the Star Wars setting, this is looking like a solid bet.

4. DC UNIVERSE ONLINE

www.atomicmpc.com.au/Review/250309

Well, we admit it – this one's a surprise. We really didn't rate DCUO highly when we played and reviewed it earlier in the year, but it seems to have struck a chord with enough people to make it into this year's top five.

Whether it can repeat the performance next year, though – that's the question.

Nonetheless, we can see the appeal of the game, and it did a very good job of presenting open world superheroic combat. Sure, it was highly four-colour, and relegating heroes like Batman to mere talking heads seemed odd, but there was certainly fun to be had in DCUO, and the pull of the franchise probably explains a lot of its success.

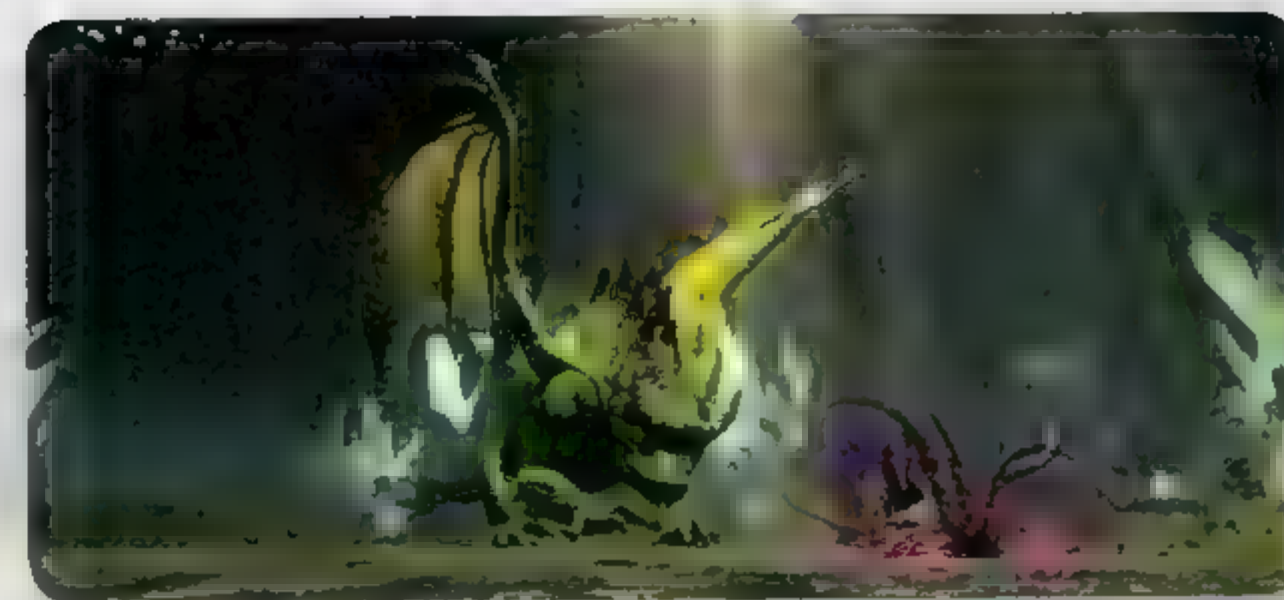
3. WORLD OF TANKS

www.atomicmpc.com.au/?264063

Now this is a game we can get behind!

WoT is not your typical RPG-based MMO, but it certainly has a massive amount of players all battling out online, and even has a persistent map-based campaign to get into. And, more importantly, it has tanks – hundreds of beautifully modelled tanks with complete tech trees to explore, XP to earn, and lots of other tanks to blow the crap out of.

It is, in other words, warnerd heaven, and a worthy inclusion to our top five. Incidentally, if you are a player, check out our WoT thread in the Atomic Forums and say hi!



2. RIFT

www.atomicmpc.com.au/?257982

The makers of Rift set out to take on World of Warcraft. In fact, the entire population of the game at times seems like it's made of people who want Rift to be what WoW is not – however, what that exactly entails is hard to quantify (*Maybe playing something with a different name is enough?* –Dep Ed).

Rift does offer up a lot of interesting options for an MMO, from constantly shifting sets of environmental challenges – in the shape of the titular Rifts – to an interesting class system that lets you combine classes to create some truly unique character combos. To our mind, though, it tried a little too hard, but what do we know – the game's made it to number two, and not a distant one, either.

Perhaps Blizz should be worried?



WORLD OF WARCRAFT

Well, they're probably not.

There's a near-constant rumble from ex-players that Warcraft's population-base is shrinking, but from our view (looking over my partner's shoulder as she raids pretty much every night or so), the game looks just fine.

The latest expansion, Cataclysm, was a huge success and showed a bold reshaping of much of the game and its world. Mists of Pandaria, the next expansion, is set to introduce a new race and add a lot more content. And that amazing player pop seems to keep going up. Of course, Blizzard is being very clever about this, with free-to-play options up to low levels, and combining subs deals with other games, but there's no denying that WoW is still very much on top – and is likely to remain there.

WHAT YOU SAID

World of Warcraft

"WOW is my staple game, I keep coming back to it."

P. Bannerman

Rift

"Great class system and well made areas."

M. Crimmins

World of Tanks

"It's Free. It's self-published. If you are a tank aficionado, especially WWII era armour, then this game is an absolute MUST."

A. Beale

DC Universe Online

"Because I can be mentored by Batman."

S. McGillivray

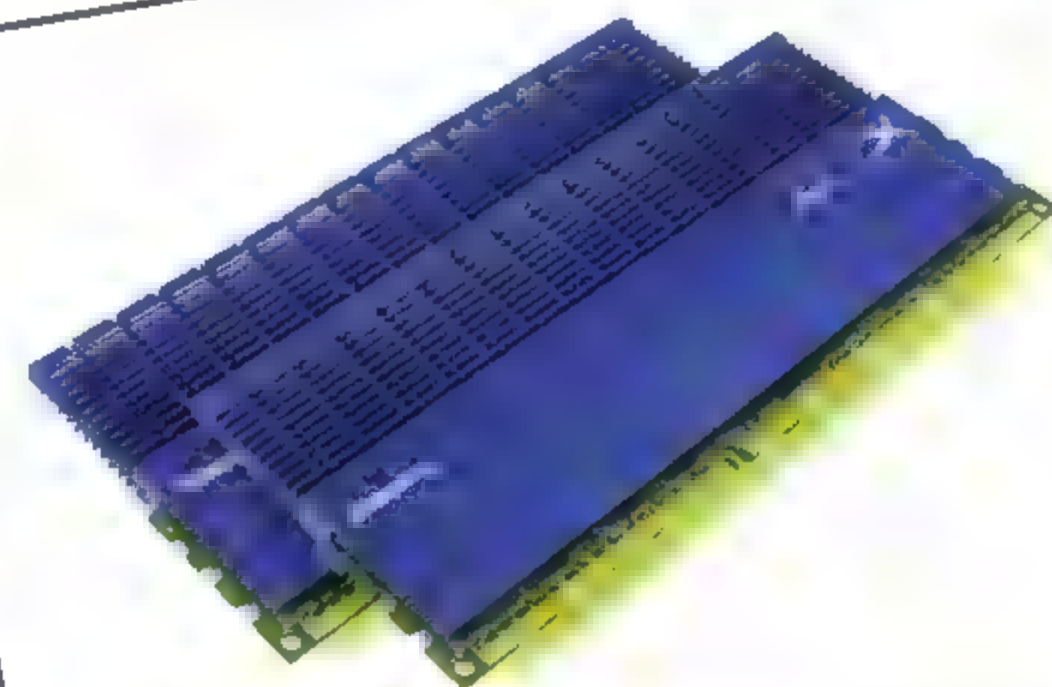
HYPER

THE MAGICAL POWER TO PRANCE INTO YOUR PC

For many consumers, owning a magic computer is always a dream. How to equip your magic computer is always what people are looking into. How to run data-heavy applications simultaneously to complete work smoothly and in time is a key issue that most professional designers are concerned about. Kingston's HyperX is the absolutely right choice for your own dream PC, showing you the performance difference before and after adopting HyperX.

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Latency Timings: 9-11-9
Voltage: 1.65V

High Performance for Professionals

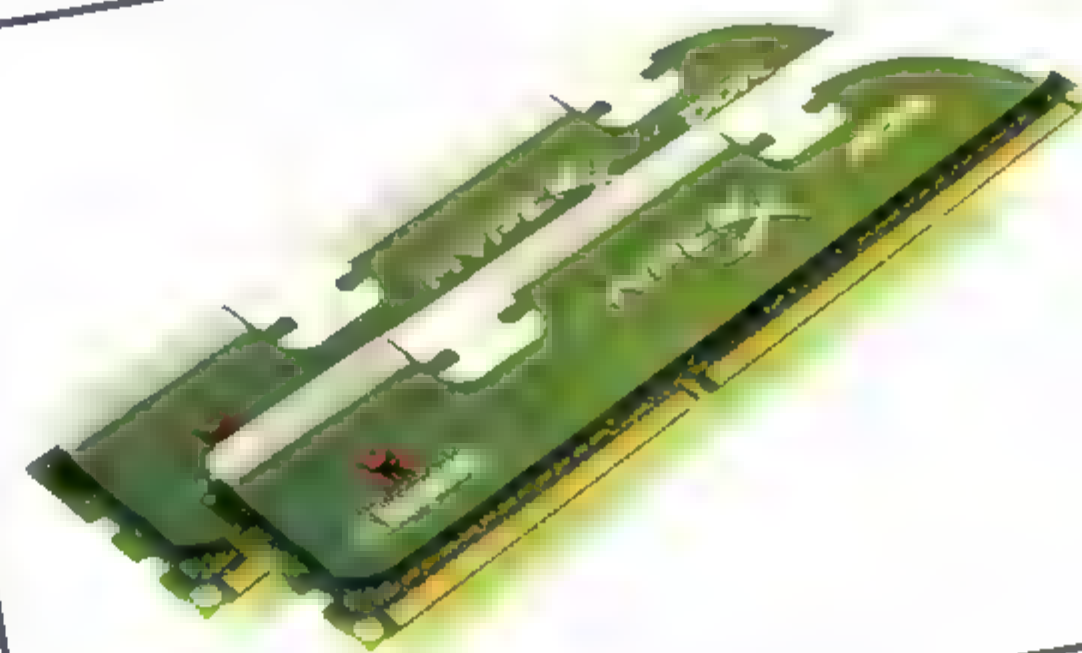


Recommend: KHX1866C9D3K2/8GX
8GB 1866MHz DDR3 Non-ECC CL9 DIMM (Kit of 2)
Latency Timings: 9-11-9
Voltage: 1.65V

Professionals such as graphic designers or video editors can't bear unexpected system crash; therefore, a durable and stable system to enhance working efficiency would be a must. HyperX has 24-hour burn-in test in $\pm 50^{\circ}\text{C}$ environment and rigorous dual/triple channel capability testing to ensure stable operation over extended periods of usage.

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Recommend: KHX1600C9D3LK2/4GX
4GB 1600MHz DDR3L Non-ECC CL9 DIMM (Kit of 2)
Latency Timings: 9-9-9
Voltage: 1.35V

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GAME OF THE YEAR AWARDS

ACTION/RPG

A last minute release comes out on top, as the rest of the pack struggles for a place – this is one tough segment!

Every year some bitter wag on our forums or site complains about what a shit year it's been for gaming. Some folks just want to make the world go 'meh', I guess, but to our mind this list alone, of our top five action games, puts lie to the idea that it's been a mediocre season.

It is most definitely an eclectic list, with games for all tastes making it across the line. But what's even more interesting is how integrated the once-traditional gaming tropes are becoming. We're seeing RPG

elements show up in all kinds of games these days, and given how many of those cross-genre games usually top lists like this one, it can only be a good thing for fans of wide-open gaming worlds.

Not to mention capes...

5. BATMAN: ARKHAM CITY

www.atomicmpc.com.au/?277247

Arkham City is a big, sprawling game. It's almost a crime-fighting GTA, it's so open, and it times it's certainly possible to feel a little lost with so much to do. But then, we can only think of a few games that deliver such a



focused super-heroic experience.

Truly, it is good to be the Batman.

And there are many different ways to be the Batman, too. Arkham City has challenges galore to complete, even beside the main quest. Were it not for Bat's ability as the world's greatest detective it would be easy to get lost, but there are so many tools and utilities to get around the city that it almost seems unfair to the criminals you're beating up.

And we've not even touched on the seductively slim Catwoman, or the voiceacting (Mark Hamill *swoon* -Dep Ed), or... trust us, there's a lot to like.

4. THE WITCHER 2: ASSASSINS OF KINGS

www.atomicmpc.com.au/?255727

It's nice to see a relatively smaller outfit like CD Projekt Red make this list, and they really deserve the praise for The Witcher 2. It's a real thinking person's RPG, with complex combat systems, real depth in the storytelling, and one of the most impressive game engines we've seen this year.

It also doesn't hurt that the protagonist is a broody, handsome fellow who's not at all hard on the eyes, with similarly attractive companions of either gender.

In fact, it's a very adult game across the board, and it's great to see games like this making an impact with the gaming public.

3. DRAGON AGE 2

www.atomicmpc.com.au/?254088

Ha! Vindication!

We cop a bit of flak from folks in the office, and from readers, for really liking DA2. In fact, we prefer it over the original – and, given the sequel's come in at the same place as the first game, Origins, we're now feeling more than a little justified.

What makes DA2 interesting is that, by and large, it's set in one location. Sure, for some, that's a gamebreaker, but we rather liked the way you got to know the city, and it got to



know you. It delivered a richer, more nuanced story, and showed that BioWare was more than willing to play around with the tropes of the RPG – and to great success, too.

Now, just don't screw up Mass Effect 3, and we'll be fine.

2. DEUS EX: HUMAN REVOLUTION

www.atomicmpc.com.au/?267789

It's one thing to get deeply into a game, but quite another to get so deep into a game that suddenly you want to start dressing like the protagonist (as ex-Atomic writer Craig Simms found out <http://tinyurl.com/Craig-DXHR>).

Those who produced it were confident enough that would be the case that they actually have a limited run of clothes made to save you the hassle. But, there you have it – that's Deus Ex: Human Revolution for you.

And no joke, too – you can buy Adam Jensen's jacket, amongst other items. And yes, we were very tempted. DX:HR is just that immersive and pervasive that you really internalise the character and the world he inhabits. A clear second-spot choice, and well-placed to boot.

1. THE ELDER SCROLLS V: SKYRIM



www.atomicmpc.com.au/?271530

Is anyone really surprised? Anyone? (Not me! -Dep Ed) This game has pretty much eaten the social lives of everyone in the office, everyone we know, and a goodly portion of the Atomic forum population.

What's really surprising is that it managed to top the list despite not being available when the GotY poll opened!

But, seriously, we can't think of another game that deserves the top spot. Skyrim just delivers so much; a mess of character options, so many ways to evolve your character, more quests and plot than most of us know what to do with, and one of the most fully realised worlds we've ever encountered. A worthy winner.

WHAT YOU SAID

The Elder Scrolls V: Skyrim

"Elder Scrolls is the RPG other RPG's aspire to."

W. Viljoen

Deus Ex: Human Revolution

"Amazing story, great graphics...cyberpunk!"

C. Blackburn

The Witcher 2

"Has to be one of the best Rpg experiences to be had."

A. Lucas

Batman: Arkham City

"I cannot fault this game. Everything is top notch."

J. Rao



GAME OF THE YEAR AWARDS

RACING

Watch gaming's best titles jockey for pole position, and other great racing cliches!

In all honesty we tend to leave racing until last because, well... it's not really our bag. Outside of a deep addiction in the late nineties to Wipeout 2097, we just don't race to relax.

But that's us – currently on the Atomic Forums one of our biggest threads is an epic discussion of all things F1 2011. In fact, it's more than a discussion; it's almost a way of life, with regular 'season' race meets, team rivalries, news services... the whole nine yards.

But that's kind of like racing in the real world. It's just how speed freaks roll.

5. NEED FOR SPEED: HOT PURSUIT

To say the Need for Speed franchise is venerable is a bit of an understatement, but one of the reasons EA is still putting out new



titles in the series is that it's willing to mix things up with the game, and Hot Pursuit is a perfect case in point.

Hot Pursuit features intense competitive multiplayer, with one set of racers being, basically, car thieves, and the other the fuzz. With NFS's usual slick style, both sides have a range of vehicles, and even access to funky things like chopper-deployed roadblocks, EMP charges and other dastardly ways to stop the badguys, while the badguys have, well... they usually get the girl. And the jewels.

It's fun, very fast, and with a mess of stat-tracking and social media compatibility, highly addictive. Just like stealing cars! Or so we're told...

4. GRAN TURISMO V

In chronological terms, GT may not be the great grand daddy of racing games, but in terms of stature – and how its fans view the game – it may as well be. GT is the first and last stop for a lot of racing game aficionados.

And hey, who are we to argue – even as a racing noob (is it a bad thing to admit I don't even have a license? [Yes, it's terrible –Dep Ed]), the sheer visual appeal of the game is hard to ignore. From the remarkable eye for detail in the tracks and settings to the real stars of the game, the cars, this is eye candy of the highest order.

It's also very challenging, which makes your success that much sweeter as you unlock car after sexy car. Just don't tell fans you don't like it – it's a sure way to start an argument!

3. F1 2011

www.atomicmpc.com.au/?272875

This is the sequel to the series that walked away with top racing honours last year, but it's fallen into third place in this year's race.

It's still a top game, though, especially on PC, and especially to our aforementioned band of Atomicans (if you're an F1 2011 fan yourself, pop into the thread – try the veal!). The attention

to detail is incredible, and from picking the right tyres to controlling your off-track career, it's a game that's as deep as it is pretty. And it's very pretty!

2. FORZA MOTORSPORT 4

Reading reviews of Forza is more like reading personal affirmations based on something like religion or yoga – this game, apparently, saves lives, can make you a better person and, we think, cure cancer.

But a minimum Metascore of 80 per cent can't be wrong, and Forza certainly has it in the looks department. We saw it showed off at E3 this year and even we were blown away by the visual fidelity of the game. Combined with regular content updates, and partnering with rev-head heroes Top Gear – down to having their test track in-game – was not a bad move either. With lots of social interactions, and even Kinect support – if you're into that kind of thing – it's a complete driving package.



WHAT YOU SAID

DiRT 3

"A great fun and enjoyable racing game, really fun with mates online too!"

J. Watson

Forza Motorsport 4

"Simply amazing and the best ever in its genre. Graphically stunning and game play untouchable."

Anon

F1 2011

"The only racing game I bought this year."

G. Tomlinson

GTV

"Gran turismo 5 hands down just for its awesome graphics and realism."

A. Noble

Need for Speed: Hot Pursuit

"Fun, fast and full of action."

M. Smees

DiRT 3



There's a lot of reasons why the oddly-capitalised DiRT 3 could be up here in the number one spot. For one thing, well... there was this whole matter of about three million leaked codes for the game showing up in the wild back in September as part of an AMD promo snafu, so perhaps the fact that lots of folks got to play it for free (and it was bundled with a mess of AMD products) has had an impact?

That said, if a game sucks, it probably still sucks even when it's free. And DiRT 3 (it's annoying to type that the other way) does not in fact suck.

It has a wealth of ways to race, from hardcore simulation modes to modes with zombies, which clearly puts it head and rotting shoulders above any other game in this list. But again, with lots of ways to hook up with friends, racing modes, and some great in-game physics, it's a real winner.

THE TOP THREE

You voted, we counted, and our sponsors helped – here's the three top Atomican-chosen games for 2011.

When you look at gaming across many years, it really does seem that history repeats itself.

Going over the conclusion to last year's poll, we discovered that we had the same observation than as now – namely that for some gamers, it just never seems enough, and that even in a year where we have Skyrim, BF3, Arkham City and even Modern Warfare, it's somehow a crap year for games.

Say what?!

But seriously, if you look just in each category you can plainly see this has been a year blessed with great titles. And a lot of them are real long-term hits, too. Let's just look at what the top three have to offer the Atomican looking for maximum gaming fun.

THIRD

TOTAL WAR: SHOGUN 2

Wargames don't get much more immersive than the Total War series, and Shogun 2 is arguably the apotheosis of everything that Creative Assembly has learned since putting out the first Shogun back in 2000 –



man, we suddenly feel really old.

But the real point is just how much there is to do in Shogun 2. Quite aside from the fact that Creative's supporting the game with the usual raft of DLC (and the first stand-alone expansion, which features the conflict between colonial powers and Japan in the 19th century has just been announced), there's historical battles, campaigns of varying length (of course, it's all about the Grand Campaign for us!), online play and more to enjoy. Plus, with so many factions, and each one offering a unique challenge, it's a game with a lot of replay value.

True to form, it's still on our hard drives, along with the last three Total War titles – but maybe we're just fans.

SECOND

MODERN WARFARE 3

Sure, you can beat the single-player campaign in a matter of hours, but the real meat of MW3 is the multiplayer and intense arms-race that is the XP-based unlock system.

It's the same kind of risk/reward structure that makes MMOs, animal experimentation and blind dates so much fun – you never know what every bit of gameplay is going to unlock, even if it's just a shiny new logo for your player tag. Hell, sometimes ESPECIALLY if it's a shiny new tag!

And the gameplay itself has dialled right down to some seriously tense, rapid-fire action. You know almost exactly the kind of match you're going to get on every map, making every nuance of strategy and tactics that much more important. It's twitch warfare taken to the highest order of twitchiness.

In other words, for a fan – and, yeah, that may not include us – it's going to live on their hard drives for at least 12 months. In other words, until the next CoD comes out.

SPONSORS

Once again, we really should thank our sponsors. Hosting, compiling and then writing something like our Game of the Year Awards is a task made much easier when you know you have the support of a couple of awesome vendors like GIGABYTE and Kingston.

And, of course, having them offer up some nice prizes for those helping us out by voting doesn't hurt either.

Now, if we can just get the makers of Bombay Sapphire, Stolichnaya and Kina Lillet to sponsor us next year, it'll be perfect. Thanks for reading!

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BATTLEFIELD 3

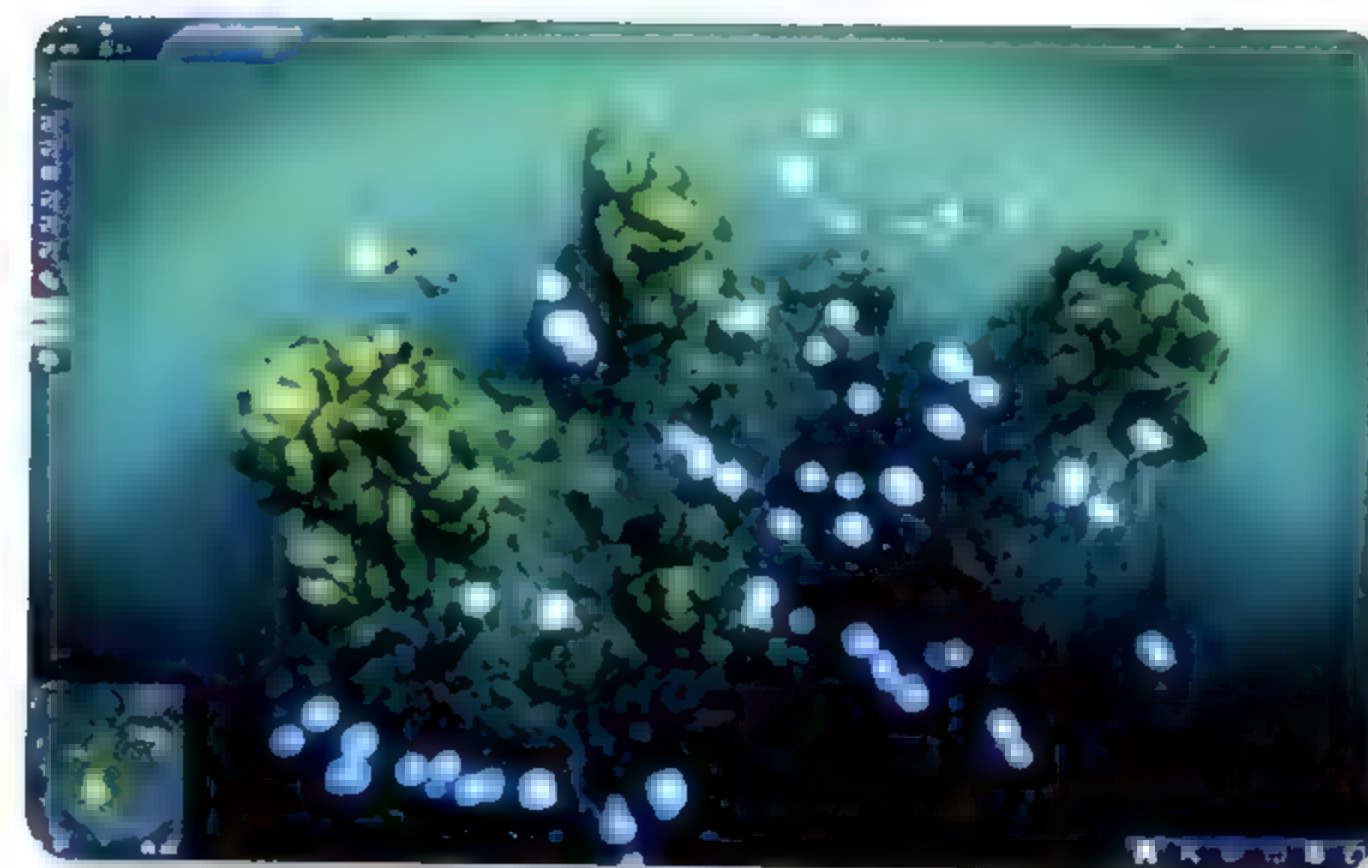
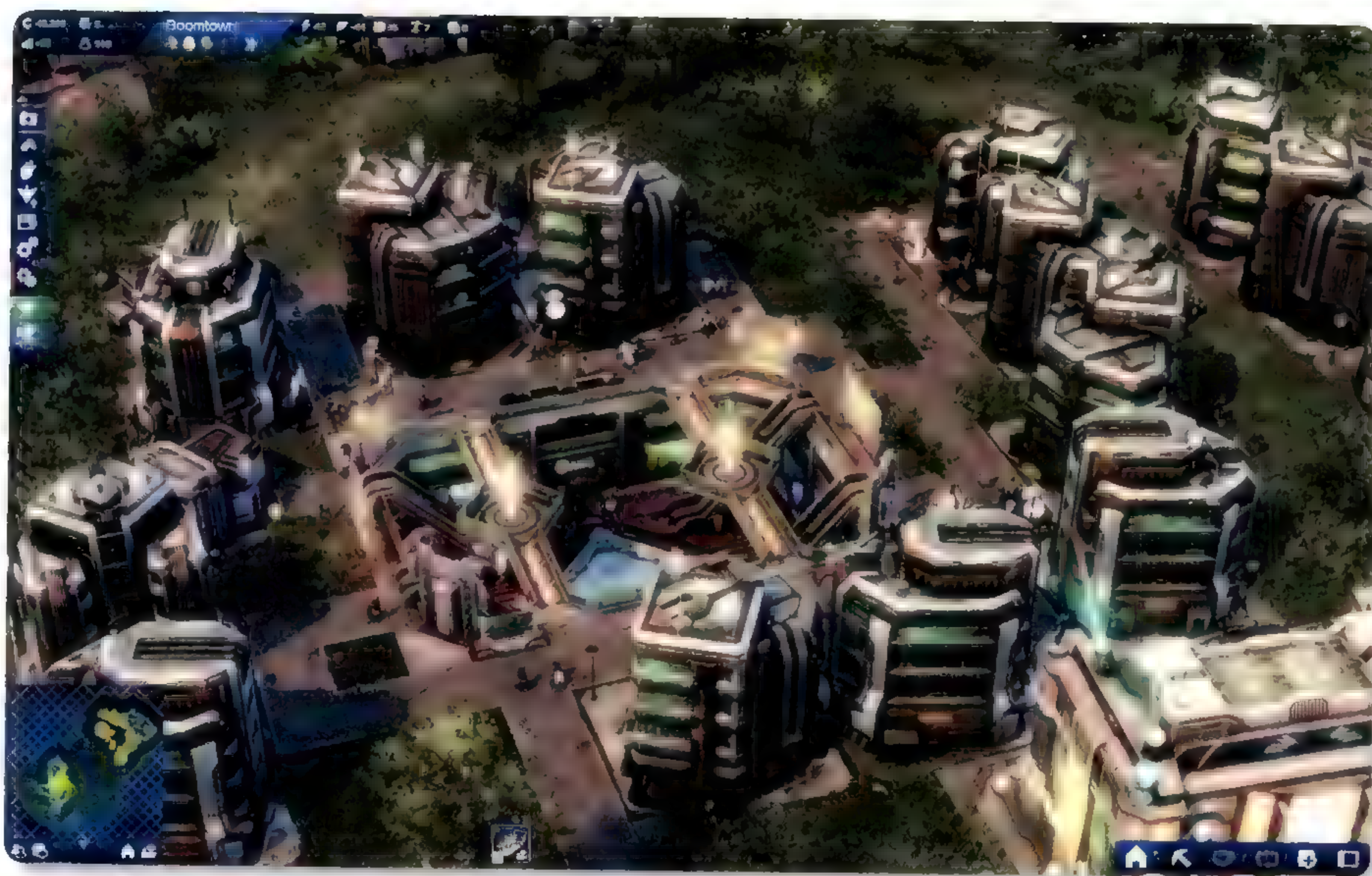
Now here's something we can get behind. There is very little doubt that Battlefield 3 will live on our HDD for years to come, and we're certain we're not alone in that assertion.

Truly, BF3 delivers everything you could want in a modern shooter. Again, the single-player campaign is easily forgettable, but that's not the game's strength. Like MW3, the real longevity comes from multiplayer, and BF3's online iteration is about as polished as you could hope for. Yes, some folks are having issues – don't email me about it! – but no one in the office is having a single issue. We can only call it as we see it, and we see this as a worthy Game of the Year.

First up, the depth. With four classes, a range of unlocks, a bunch of gadgets and even vehicle gadgets to play with, you never know what kind of enemy you're going to come up against, and tailoring your own kit-out for various maps and situations is almost a game in and of itself. Then there's the game itself, with deathmatch, rush, and conquest modes all included, from squad-sized matches all the way up to epic 64-player brawls; combine those numbers with FrostBite 2 and you hit a whole 'nother level of gaming. To our mind, it's like having a dozen games of MW3 all happening at once, while tanks and jets fight outside – that's the kind of scale we're talking about. And the sound design is truly best of breed, wrapping all of the above into a perfectly immersive package.

Well done DICE for delivering on all the promises, and well done EA for letting them. Bravo. Now, if you'll excuse us, we're off to deliver some withering cover fire on Operation Metro in Conquest mode – it's a pretty tough job, but someone has to do it.





ANNO 2070

People of the future will subsist on nothing but fish and tea.

I'll preface this review with a disclaimer: I am a total ANNO newbie. I've never played 1602, 1503, 1701 or 1404 – though do enjoy city-building games in general. ANNO 2070, as the title so cleverly hints, is set in the far-off future where global warming has caused sea levels to rise, reducing the available landmasses to mere islands. This doesn't appear to be much of a hindrance as there are islands a-plenty, and it never feels like you're running out of places to expand to.

As a traditional city-building sim that feels somewhat like *Children of the Nile*, 2070 mixes things up with two-and-a-bit factions to choose from: the Eden Initiative (think watered-down Greenpeace) and Global Trust (industrial super-consumers). Each faction plays out relatively identically at the start, settling islands first with a warehouse that acts as trade centre and goods storage, a town centre that is surrounded by houses that generate income, and depots that allow the depositing of mined resources. Unlike others in the genre these depots and warehouses do not need to be linked by road, so independent resource-generating pockets can be established with relative ease. Basic construction materials are created and fish are caught to feed the growing army of workers.

From here the two factions split apart. Eden focuses on renewable agriculture and wind power, requiring large amounts of room. This is further exacerbated by each food-producing structure requiring the placement of up to eight individual fields – when you've got an entire island covered in farms that you've placed manually, it can get a bit click-intensive. There is an auto-field option that creates inefficient layouts for the fields, but it's mostly a waste of time. Few structures can be placed over water.

Global Trust is similar to what we experience today in Western society: lots of rotary coal extractors, coal-fired power stations, fast food restaurants and casinos. Naturally these options create quite a bit of pollution, which reduces the 'ecobalance' of the island and thus affects fertility of their limited farming – though this can be mitigated by simply farming on another island, transporting finished resources by freighter, and polluting all you want (then dealing with the inevitable respiratory infections).

The final faction is the S.A.A.T., who are not playable as a sole faction and instead can only be used synergistically with one of the two main factions. They focus on high-tech, high-cost buildings and resources, and allow the development of futuristic weapons and structures. And yes, frickin' nukes are an option. S.A.A.T. also allows construction of a submersible trimaran, which can found a new settlement on underwater plateaus – unlocking additional resources and tech paths.

Unfortunately, 2070 never really explains how to go about most of these things – though hinted at during missions with infrequent arrows, the game requires that you read through pages of 'data logs' for an idea of what structures are needed and how they interact. A great example is taxes; mentioned frequently as being a hindrance to population development, yet never explained in documentation (it's accessible by clicking on a house, then moving a slider across a non-labelled coloured bar. It's uh... intuitive?).

Traditional continuous play modes are included alongside special one-off missions that update every few weeks from Ubisoft's servers, and a campaign mode. This pulls double duty as a tutorial, but again, is relatively unclear at explaining how to play. Most missions are

uninteresting affairs involving 'take your ship here, pick up X item, deliver it here'. The voice acting is horrendously delivered, and barely serves to create a narrative. Basic mechanics like income are also not touched on well, causing the failure of one mission because we simply ran out of cash – and couldn't fix the problem by building new structures because... well... structures cost money. That's not to mention the skirmish AI players in continuous games who build third-tier structures from the start of the game and never seem to need resources, or who have access to an array of decorative pieces that make their cities more interesting than yours.

To the game's credit the visuals are spectacular, and environments are vividly brought to life with detailed animations and surprising attention to detail, framed by a stellar soundtrack. It rewards those who zoom in.

It's not a clear purchase, and the always-on DRM will put some off, but there's fun to be had here for fans of the genre – if you're willing to put the time in to work it out for yourself. **JR**

PC

Developer Related Designs/Ubisoft Blue Byte
Publisher Ubisoft
Website <http://anno-game.ubi.com/anno-2070/en-GB/>

Gameplay

Unfair AI, unhelpful and boring campaign, but solid city-building.

55

Graphics

A visual treat that rewards inspection.

90

Sound

Great soundtrack, painful dialogue.

80

Overall

A flawed diamond that's hard to love, but fun to play.

71%





Saints Row: The Third

A game so bad, it's good.

Games, much like other artistic ventures, have the capacity to teach, to inspire, to evoke emotion; films like *Citizen Kane* demonstrate a perfect understanding of how to craft a timeless and engaging narrative while also portraying fleshed-out characters. TV series such as *The West Wing* can demonstrate the ability to address moral quandaries, and titillate us with tales of political and diplomatic intrigue.

And then there's stuff like *Keeping Up with the Kardashians*.

Some may look at *Saints Row: The Third* as an opportunity to have the same tired conversation about questionable content in games that's been raging for decades. There is a great deal of content in the game that will offend, but with two rather notorious games in the series already, it is hard to say whether they've crossed the line any more than they have previously. The truth is the *Saints Row* series doesn't do much more than fill the gap Rockstar left when they decided to take *GTA* down a more realistic path.

One great new feature in *Saints 3* is that it actually functions on PC; the port of the previous game was so appalling that the ability to play *The Third* at all comes as a bit of a shock. Once in the game you'll notice the shiny DirectX 11 support makes this a very good looking, albeit stylised, port. Despite the inherent console-iness, the engine does the job admirably. The only issue with presentation we found was that NPC civilians, police, army units and enemies are all clones of about three or four models from each group.

The game starts explosively, and in the typical *Saints* fashion of total insanity. You create your character in immense detail and

soon enough an excuse is made to find a new setting so you're not bored with the old locale of *Saints 2*.

The missions are diverse, with locations and objectives varying greatly. Sometimes you're blowing up buildings, sometimes you're riding shotgun in a helicopter firing rockets at cars, followed up by rappelling down a building and sniping enemies as you dangle.

The weapons are also quite varied, with the introduction of the awesome new predator drone, which is pure and unadulterated fun. The rest of the weapons will leave you feeling pretty 'meh', but upgrades are available and give the guns more punch. And yes, there's a purple dildo melee weapon.

Amongst the chaos, the core of *Saints* games is territorial and financial control, so you'll need to be mindful of your influence in the world. This inevitably changes in a linear fashion as you complete missions, but it is nice to see changes in the game world as you progress. The story is suitably ridiculous, but given the game features in-depth character customisation, we felt attached enough to our character to be engaged in his rise to the top.

Saints 3 also has one of the best two-player online co-op experiences available. There is endless fun to be had completing the campaign with a mate, as well as just blowing stuff up and going on the run from rival gangs and the authorities. You can compete in co-op activities or work together to complete them, and it all fits together beautifully, because the game accommodates two players from the ground up. We weren't playing the final code, but for the most part the online experience was bug and lag free.

The game also has a great cinematic flair;

the cutscenes are astonishingly well directed at times and certain visual parts of the game scream, "I'M A TRIPLE-A TITLE, BITCHAAAAAS". Then people talk. The dialogue is so bad, but in the best way possible, really. It is the kind of bad you have to try for. It's a bad you laugh with, not at. It's a cringe-inducing, did-they-really-write-that kind of bad.

The final note we'll make is this: at the end of the day *The Kardashians* may be a show centered on moronic attention-seekers whose only real purpose appears to be thieving a combination of nitrogen, oxygen and a number of other elements and chemical compounds from the good people of Planet Earth, but if mindless trash can be awesome to watch, it can also be a lot of fun to play. (F) JL

PC, PS3, 360 (reviewed on PC)

Developer Volition, Inc
Publisher THQ
Website www.saintsrow.com

Gameplay
Risqué and fun, with great co-op.

90

Graphics
It pales compared to BF3.

70

Sound
Terrible voice acting, average effects.

60

Overall
It's not *Citizen Kane*, but it's still worth a play-through.

80%



Assassin's Creed: Revelations

The third game in series hit all the right notes, but never really strikes a chord.

Does familiarity always breed contempt? Possibly not, but it can definitely be difficult to get overly excited about something that feels too familiar. As the third game of the Assassin's Creed "Ezio trilogy", Revelations technically takes place directly after Brotherhood, with Desmond Miles still comatose and stuck in an increasingly fractured and unreliable Animus. While he's experiencing Ezio's life, however, the action has moved forward to the 16th Century, with an older Ezio travelling to Constantinople in search of a way to unlock a secret library of Assassin secrets. In an intriguing and enjoyable gameplay twist Ezio himself experiences sequences where he relives parts of Altair's life, giving players access to all three of the playable characters from the previous titles. It's a great bit of story-telling (with one or two 'revelations' as promised by the title) and it's hard not to think of Inception a little when playing.

Magnificent Multiplayer

The superb multiplayer returns in Revelations with a few new bits that really enhance the experience. Players get more character customization in terms of appearance and weapons, along with guild support. So-called story-oriented quests give some insight into Abstergo, while a capture the flag mode offers a more fast-paced game to the more methodical style of the original. Much more fun than it really has any right to be.

Age shall not diminish him

As we said before, Ezio is looking a little grey and weather-beaten by the time he turns up on a dock in Constantinople. While he's aged in appearance, Ezio's verve and agility remains impressive – as does his occasional tendency to leap in utterly random directions while climbing or free running.

Early in the game you gain the hook-blade – a wrist-mounted device apparently common in Turkey but unheard of outside of Constantinople. This opens up some new moves for Ezio – quicker climbing, the use of zip-lines, and some new combat options. However, it really doesn't add much to the game overall – climbing is a little quicker and some combat animations change, but you'll feel it most of all when zipping around town like Nathan Drake before performing a few extremely satisfying flying assassinations.

Ezio's magical Eagle Vision has changed a bit, working a little like Batman's detective vision in a few cases to help you track guard movements or identify suspects and evidence. Assassin squad management makes a return from the last game, with Ezio once again mentoring a new crop of recruits, this time in a slightly more avuncular fashion thanks to that stellar grey beard action.

With a bang

Bombs make an appearance too, with a local assassin rather amusingly exhorting Ezio to 'get with the 16th century'. Ezio learns to craft a variety of different bombs for distraction, traps

or outright damage. It's almost a mini-game, mixing up explosives on specially design crafting benches, but we didn't find ourselves really using them very often. It was also a little annoying to start finding bomb components extremely early in the game, without any way of using them.

Finally, the addition of a tower defense style mini-game for defending Assassin Dens against Templar attacks was actually a considerable irritation to this reviewer, who has spent a lot of time not playing tower defense titles for a very good reason. Luckily it wasn't overly impactful on the game as a whole and it may have more appeal for other players.

It's worth noting that everything mentioned above is in addition to the town rebuilding elements from Brotherhood. This makes for a game that's a little jumbled and convoluted at times. Add in the already complex plot, and the strangely Tron-like first person platforming sections exclusive to Desmond, and Revelations comes off a little bloated – it could stand to lose a few elements and get back to its Assassins' Creed II fighting weight. (E) **NH**

PC, Xbox 360, PS3 (reviewed on Xbox)

Developer Ubisoft Montreal
Publisher Ubisoft
Website www.warthenorth.com

Gameplay
Fun, but bloated with polarising elements.

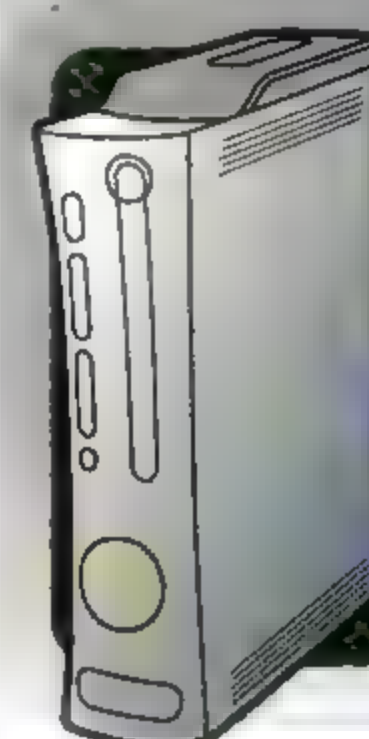
79

Graphics
Beautifully rendered and involving.

90

Sound
Amusingly written dialogue abounds.

92



Overall
Not as tight as we would have liked, but still a worthy end to the series.

81%

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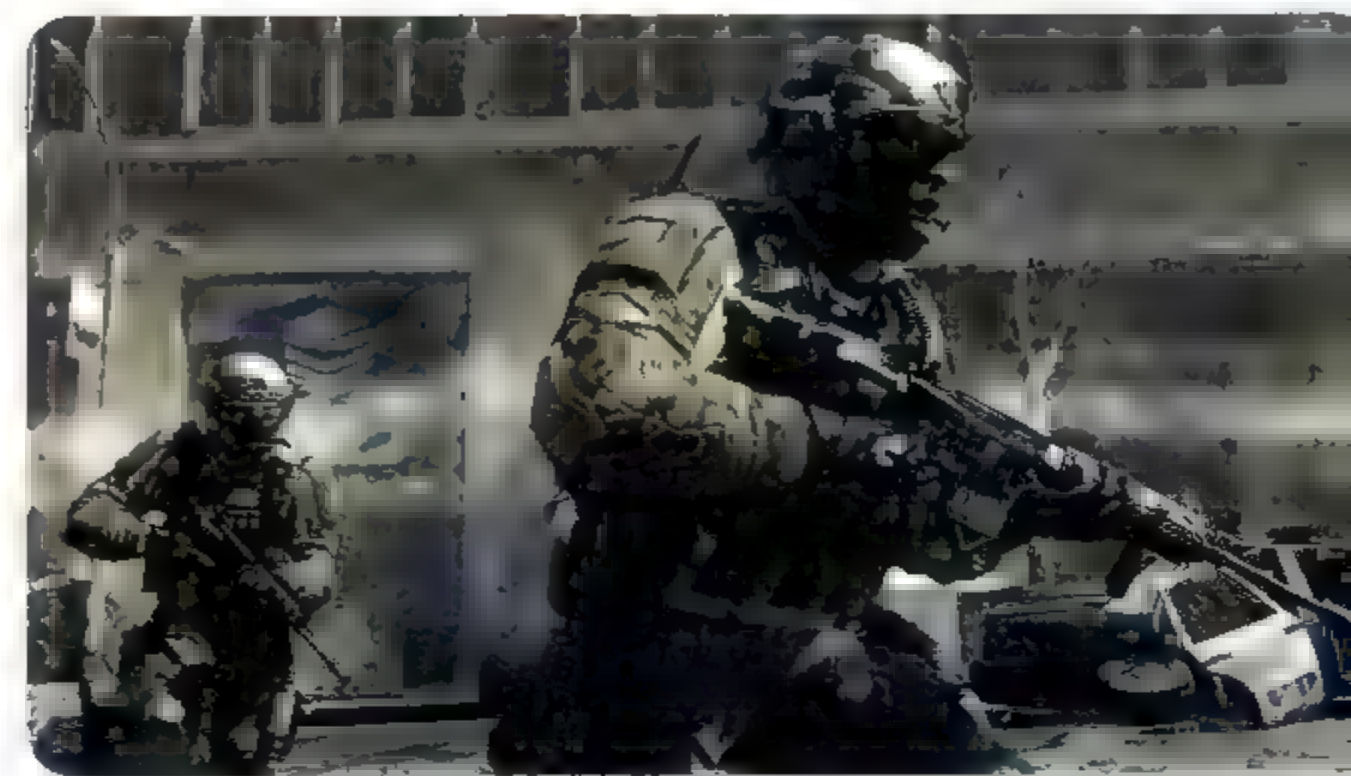
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Call of Duty: Modern Warfare 3

An epic conclusion to the 'Makarov Trilogy'.

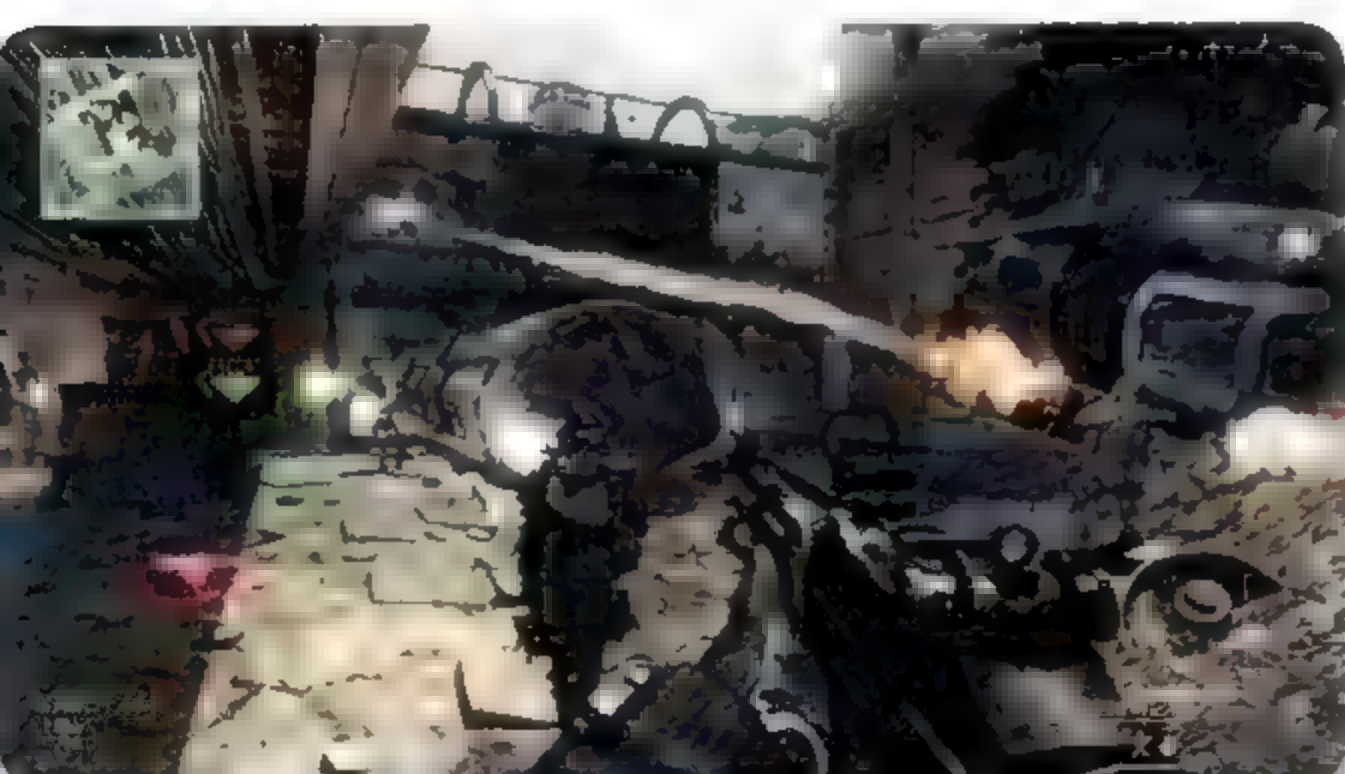
I'm well-known for not being a huge fan of the two recent iterations of Call of Duty. In fact, we initially didn't get sent the game for review because Activision was all too aware of this. However, we did eventually get it, and in all honesty rather looked forward to the experience – after all, Modern Warfare 3 closes out the trilogy started in CoD4, which is still one of our favourite games of all time, and we're suckers for a bit of closure.

And, hey, there's a certain appeal to the brutally fast and often lop-sided multiplayer, too.

A war to end all wars

Boy, have Infinity Ward outdone themselves in epicness with the game's singleplayer. It's still highly linear, and falls into a lot of the old issues we have with CoD and many modern FPS games, but when you're in the middle of a large-scale firefight on the deck of a submarine with the world burning behind you as a backdrop, there's no denying that it's a truly unique and somewhat awe-inspiring experience.

It's these moments where the game is at its adrenaline-pumping best, with so much



going on around you that you almost literally don't have time to think. It's just move, shoot, move – video game action distilled to a sort of baseness, in locations all over the globe, as Russia invades pretty much all of Europe. Over the top? Sure, but nothing breeds succeeds like excess.

The campaign is short, but it's almost a good thing; the gung-ho attitude that seeps through the game would be hard to take in longer chunks, and it means that the cliched tricks that IW pulls (the now-classic killing of playable characters, the many times things seem to happen well outside of your control in slow motion) don't get too annoying. MW3 is still pretty much a clone of previous releases, and the game engine powering it all is starting to look old, despite Activision's many protests to the contrary. It especially pales compared to engines like FrostBite2 or the CryEngine. However, the larger scale of MW3 means you can mostly ignore all that and just have fun. And hey, it means you can get to multiplayer even faster.

Activision has made a lot of noise about the changes to multiplayer, but really, they don't amount to much in practice. The new Strike Package system makes you think you're getting something different, but in the end you'll still be cursing about the uncanny ability of that one player who constantly calls in choppers and airstrikes to nail your arse without even exposing himself to your fire. CoD multiplayer's strength is not innovation, but rather the opposite – you literally know exactly what you're getting. For some it's like a favourite blanket, all comfy and reassuring, but for others

– and we fall into this camp – it just makes each new game feel more like an expansion pack for CoD4, and in many cases, expansions that feel worse while the underlying engine continues to age ungracefully.

The core of the multiplayer combat isn't bad, though. Excellent hit-detection and satisfying ballistics, not to mention lovingly-modelled weapons, are appealing. Sixteen MP maps at launch is a pleasant surprise, too, but the game's appeal is more of a coke and burger at McDonalds than a real meal – it fills a hole, but compared to the larger and more complex experiences of Battlefield 3, it's rather lacking. And that's not even mentioning that the CoD community does tend to be a little rage-inducing at times – there's only so many times we can be called fags before we turn to a game with a more mature community.

If more of the same is what you're after, then Modern Warfare 3 delivers in spades, alongside a singleplayer campaign that is about as epic in scale as it can get and not implode under its own weight. It's fun, but hardly groundbreaking and it's not going to whet our appetites for long.

Just like that Maccas meal... (DH)

PC, PS3 and Xbox 360 (reviewed on PC)

Developer Infinity Ward
Publisher Activision
Website www.callofduty.com/mw3

Gameplay
Tried, true, and getting a little tired. **74**

Graphics
Not quite retro yet, but hardly 2011-grade. **72**

Sound
Easily the best aspect of the game. **89**

Overall
IW reinvent nothing, and deliver pretty much the same old wheel.

73%



Lord of the Rings: War in the North

Take the fight to the Shadow in this gritty and brutal spin on Middle Earth.

One of the great things about Tolkien's Lord of the Rings cycle is that it is, almost literally, just the tip of the rather large iceberg of work he generated when he created Middle Earth. Standing in the mists of time before Frodo and Aragorn are three long ages of history, gods and monsters that would make Sauron positively piss himself, and a rich cultural tapestry that is profoundly deep. If you, like me, are the kind of fan that loves to immerse him or herself in the other parts of Middle Earth and you're a gamer (which is a safe bet if you're reading this), then Snowblind's Lord of the Rings: War in the North, is like candy to a diabetic.

It's an irresistible treat, in other words, but the analogy holds more water than that. It is a lot of fun, but like candy, it doesn't have any real substance to it, and too much can get very, very tiring.

And my [insert weapon here]

War in the North is based upon references in Tolkien's Lord of the Rings that there was more going on in Middle Earth than what the Fellowship encountered. While Gondor was under threat, armies were marching on other powers not explicitly mentioned. It's a heady idea but if Snowblind's done anything wrong, it's that it hasn't gone quite far enough.

It's nice to have a game that doesn't simply plonk you down as Aragorn, but at the same

time these characters are just as set in stone. You can choose from the Ranger Eradan, the Dwarven warrior Farin, or the Elven Loremaster Andriel; for balance reasons, you'll always have this ranged, melee, magic split, and for story reasons you'll be stuck with these three characters. Again, it's bit of an issue, because the story just isn't as deep as we'd like – and will inevitably disappoint those who dig exploring Middle Earth.

The thing that War in the North really takes away from the movies is the combat, that sense of weight and dynamic action that the film really nailed. It does so with such devotion that the game is more hack-and-slash than RPG; it's like Diablo, really, from a different camera perspective. Which is not to say that the combat is unsatisfying; in fact, it's possibly one of the better games of this style that we've seen recently. It's certainly better than Hunted: The Demon's Forge (www.atomicmpc.com.au/?267772). Whether you're the healing-focused Elf, or the shooty Ranger, the branching skill paths you can unlock let you work on making your character fight just the way you want. As Ranger Eradan (who we just called Ranger Dan) for example, you can focus on melee or ranged attacks, and beyond those there's room for serious tweaking. With the immense amount of loot you find on dead things and hidden chests, you'll soon have a character that is skilled and geared just the way you want.

That's not to omit your Great Eagle pal,



Beleram: calling him down to smite enemies is just too much fun, and adds a layer of epic-ness to the game that is actually quite immersive.

As fun as the combat is, though, it does dominate the game. Open-ended level design, pacing, and plot all take second place to creating linear combat arenas. Some of them are rather stunning, and all the Orc-hunting is certainly fun, but we can't quite escape the feeling that a deeper plot – or even a plot with some far-reaching repercussions or more player control – wouldn't go astray.

More fun with... more

This game is ultimately all about co-op action, and with friends along for the ride, the game overcomes much of its flaws as you cry out for healing, or for help downing a tough opponent. Played solo, though, the game's flaws are exacerbated, especially considering the rather pedestrian fellowship AI. So, stock up on snacks, friends and caffeine, and the game can be fun. But maybe don't invite your seriously nerdy, Middle Earth-loving pals. **DH**

PC, Xbox 360, PS3 (reviewed on Xbox)

Developer Snowblind Studios
Publisher Warner Interactive
Website www.warinthenorth.com

Gameplay

Fun combat, but it's not the deepest of RPGs.

76

Graphics

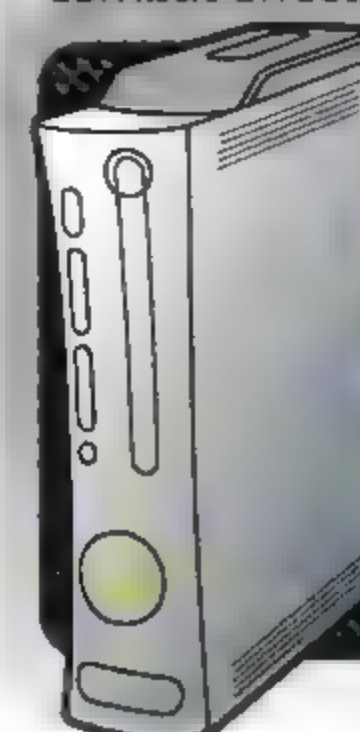
Great design and attention to detail.

84

Sound

Mostly solid voice work, some great combat effects.

82



Overall
Not perfect, but fun with the right attitude.

79%



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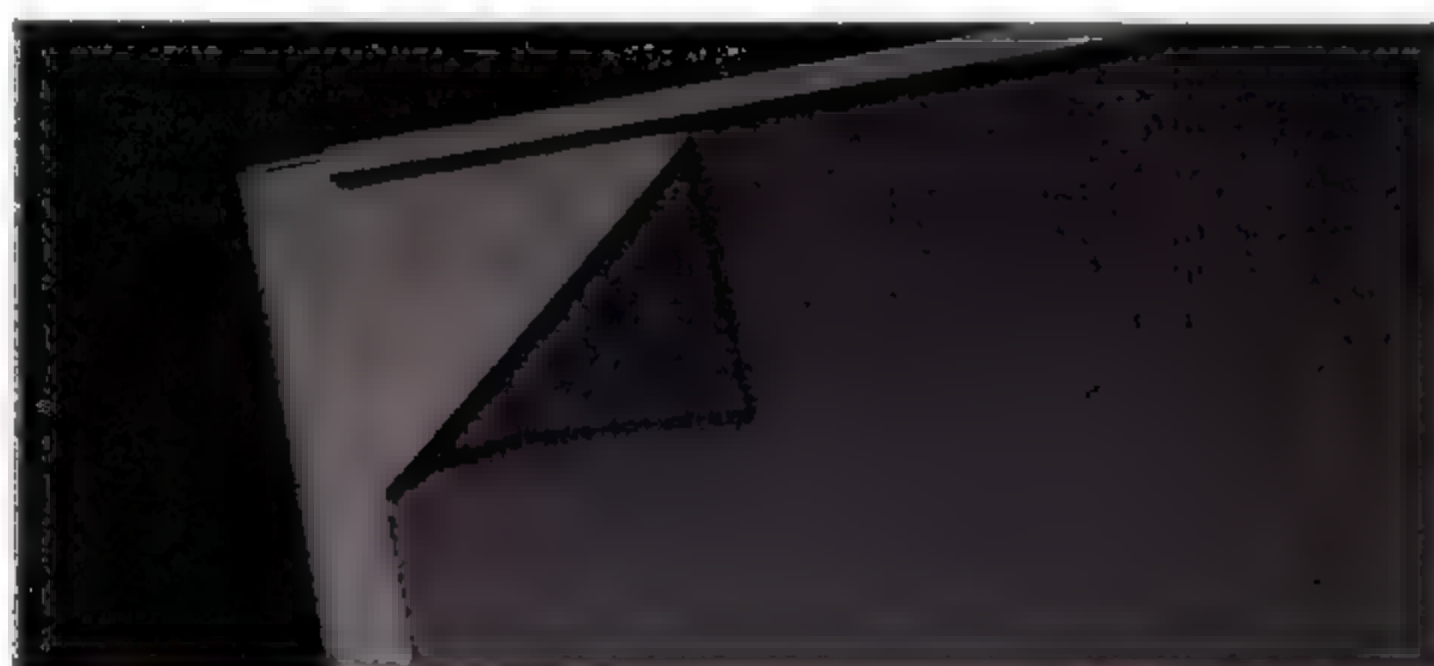
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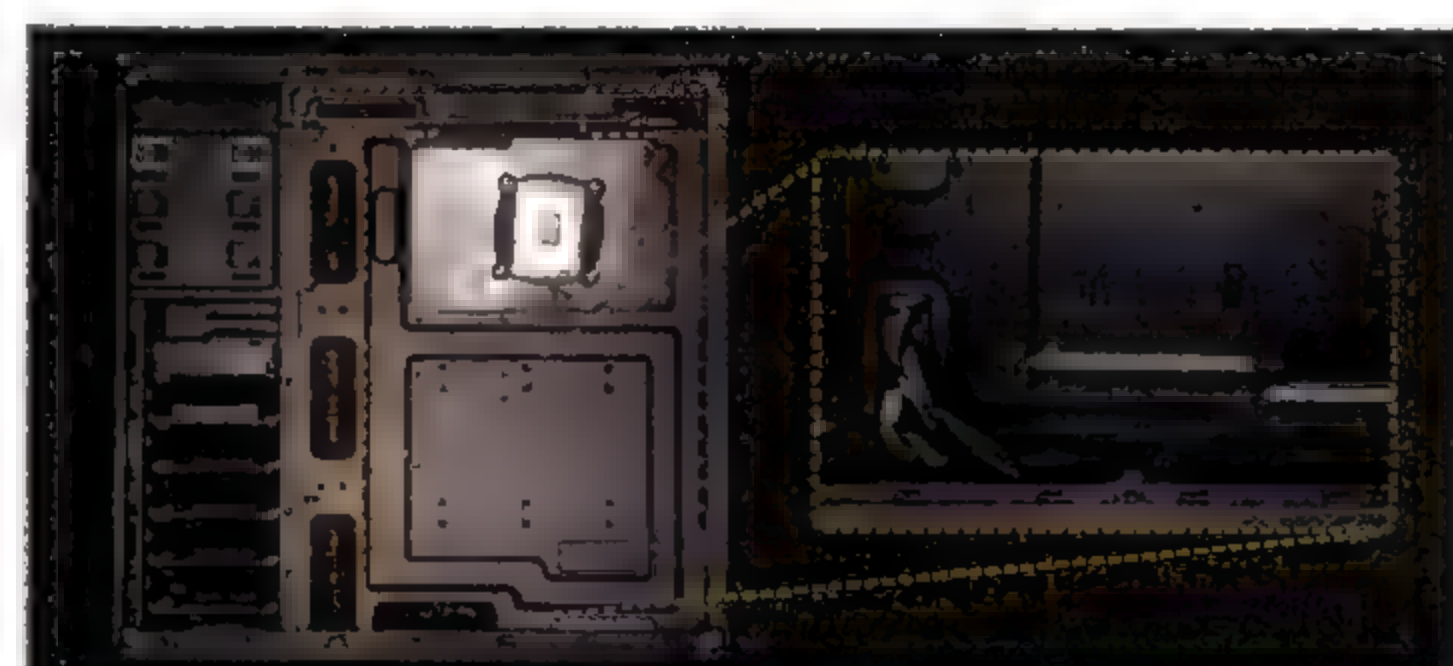
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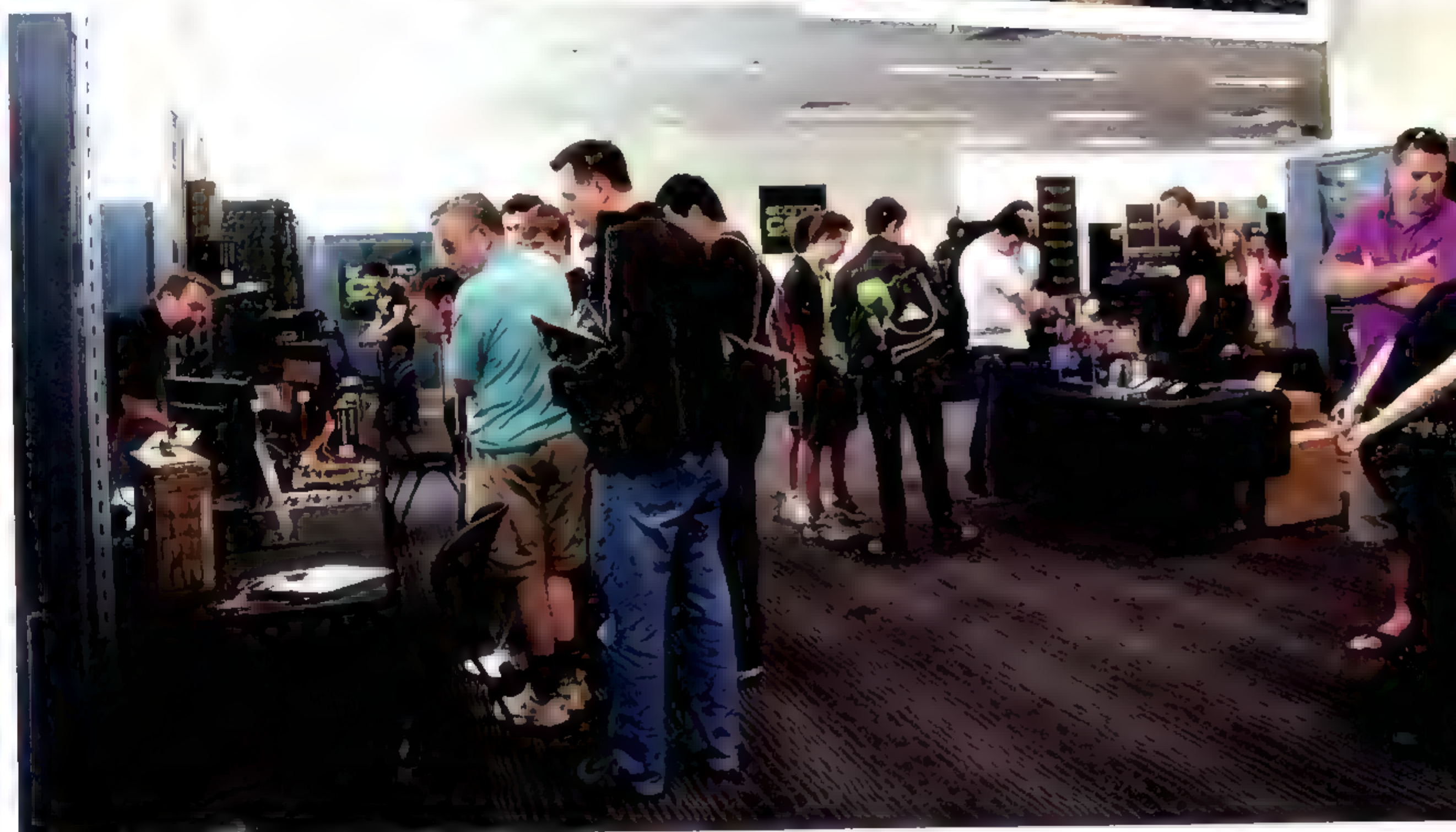
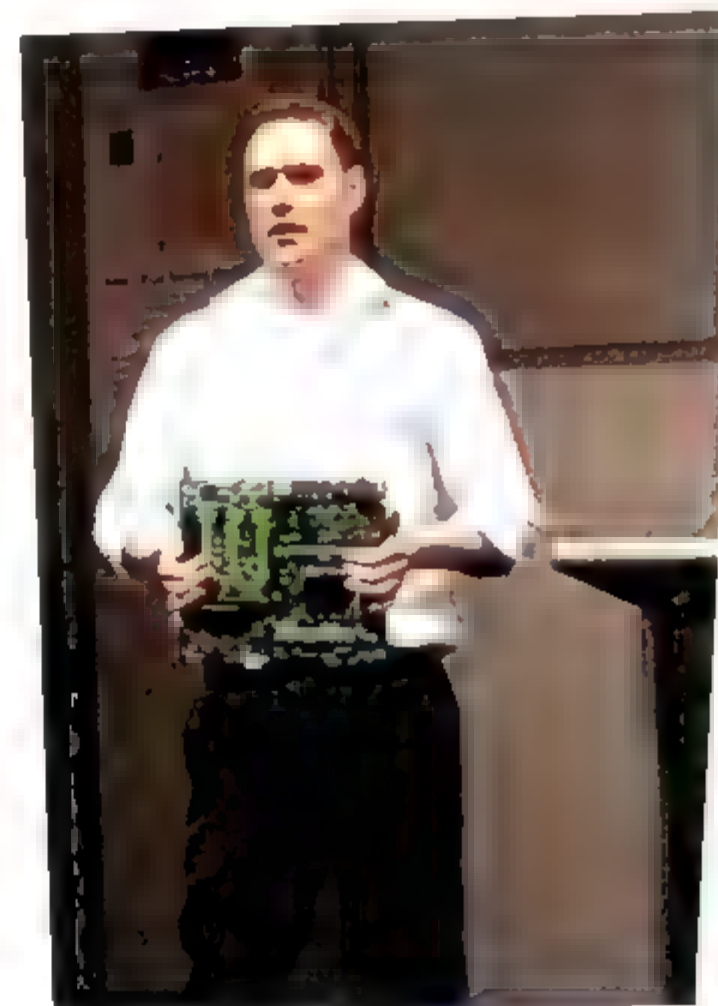
A very unconventional convention, brought to Melbourne by Atomic.

AtomicCon was held at Monash University on Saturday 12 November, where we had a huge number of Atomicans taking part in our latest and greatest gathering of hardware and games.

GIGABYTE kicked off the hardware display by demonstrating extreme LN2 overclocking with their latest motherboards, giving Atomicans first-hand experience at this very cool activity. The GIGABYTE reps

were more than happy to answer any and all questions pitched about their products.

Also set up were AVerMedia, who were showing off their Game Capture HD box; an external unit that can be run headless (without a PC), and records content from a PS3, Xbox 360 or Wii for later viewing or uploading. Had a really good teabagging run in Halo? Now you can show your friends in HD.

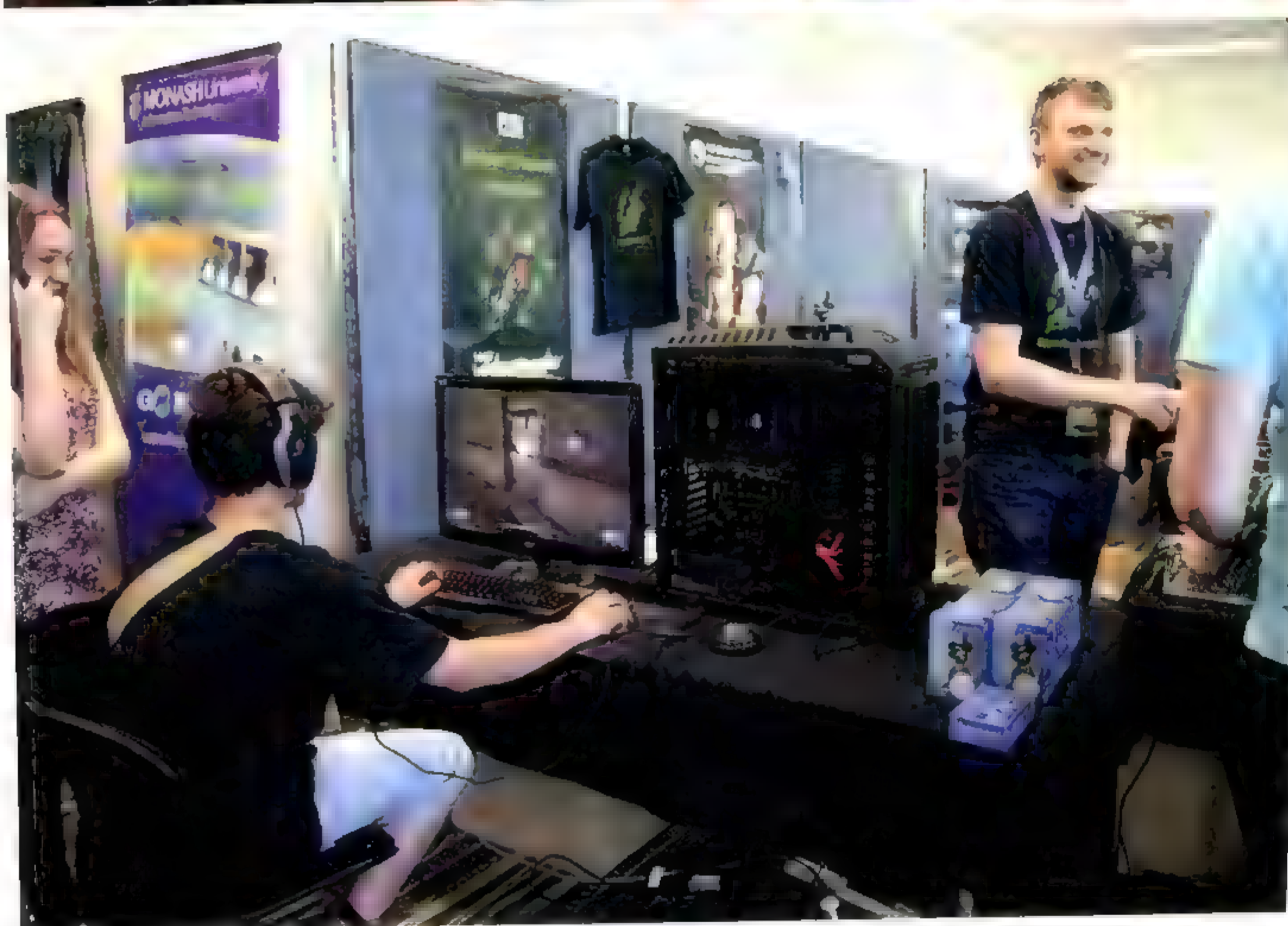
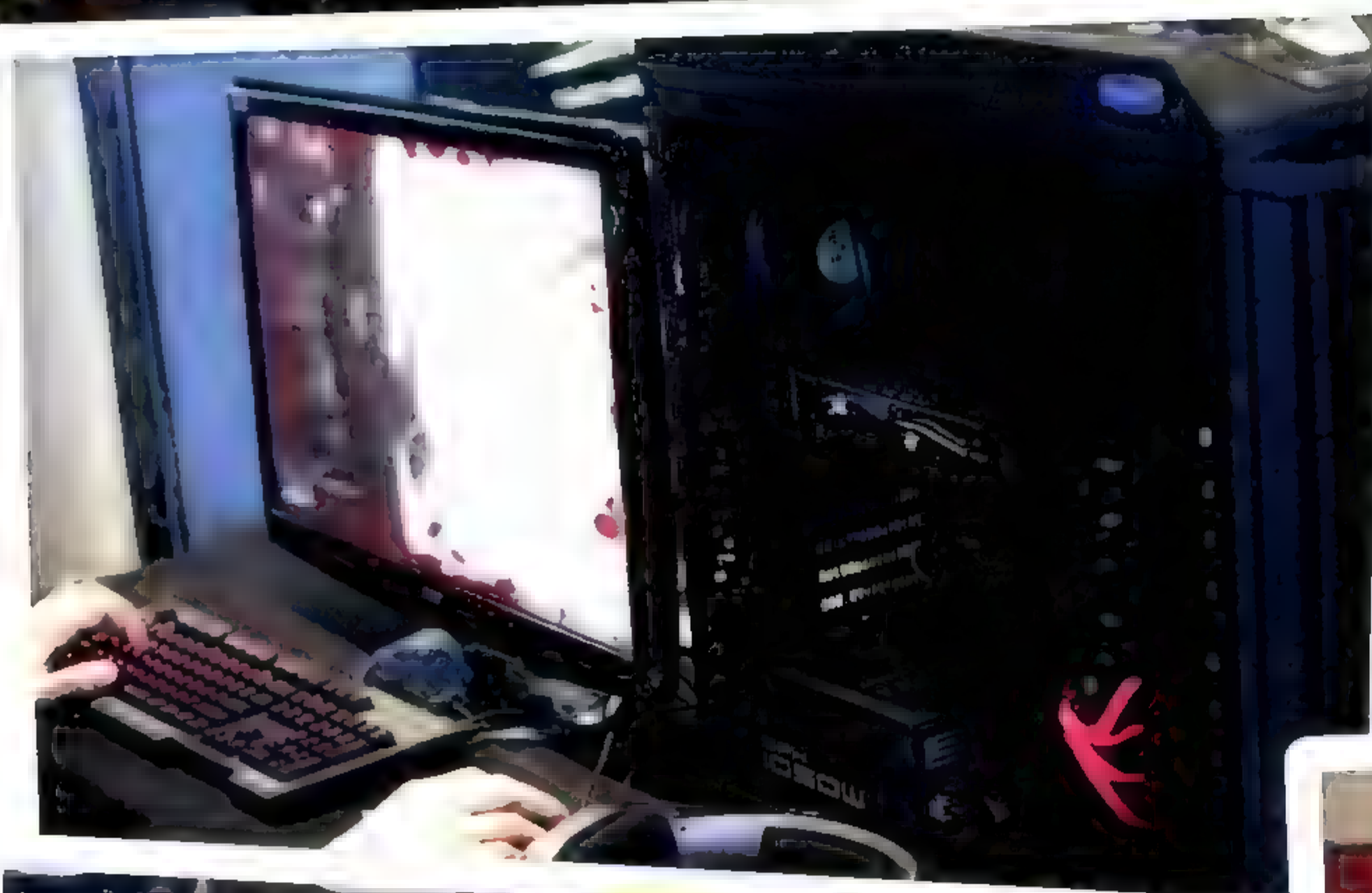




Our good friends at Western Digital also made an appearance, bringing along their latest storage devices – and giving a few away to boot! Rotational media's far from dead, as they enthusiastically displayed their range of wares.

Not to be outdone, Antec brought their Darkfleet series of cases along, crammed some hardware into them, and let Atomicans play Modern Warfare 3 to their heart's content. What better way to get to know a product than to see it in action?

Also in the gaming-as-a-display-tool group were Corsair, who ran systems with Counter-Strike (no wallhacks were present). They had brought along a giant wheel, and a few lucky Atomicans scored themselves anything from a brand new SSD to a Corsair pen. Neat!

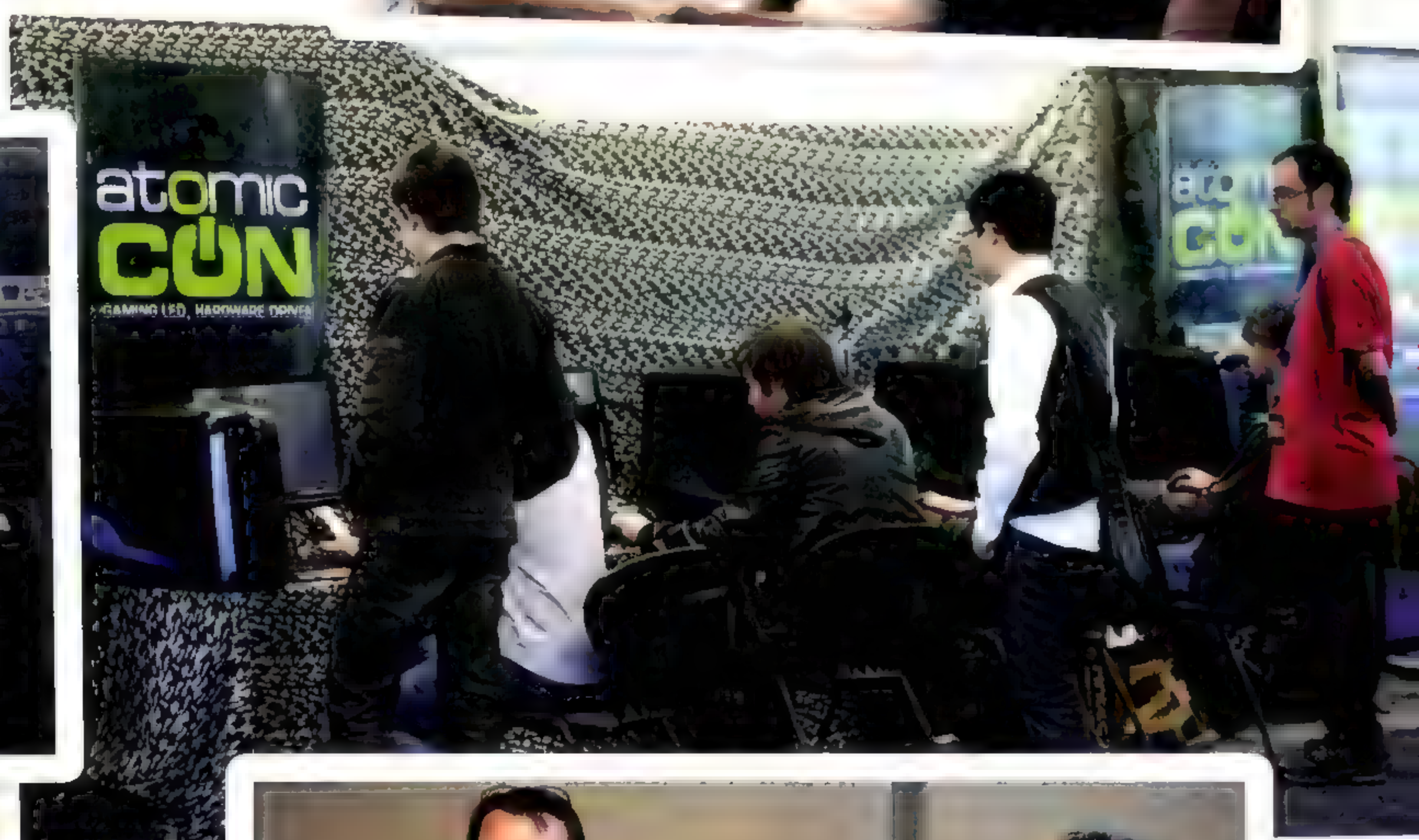


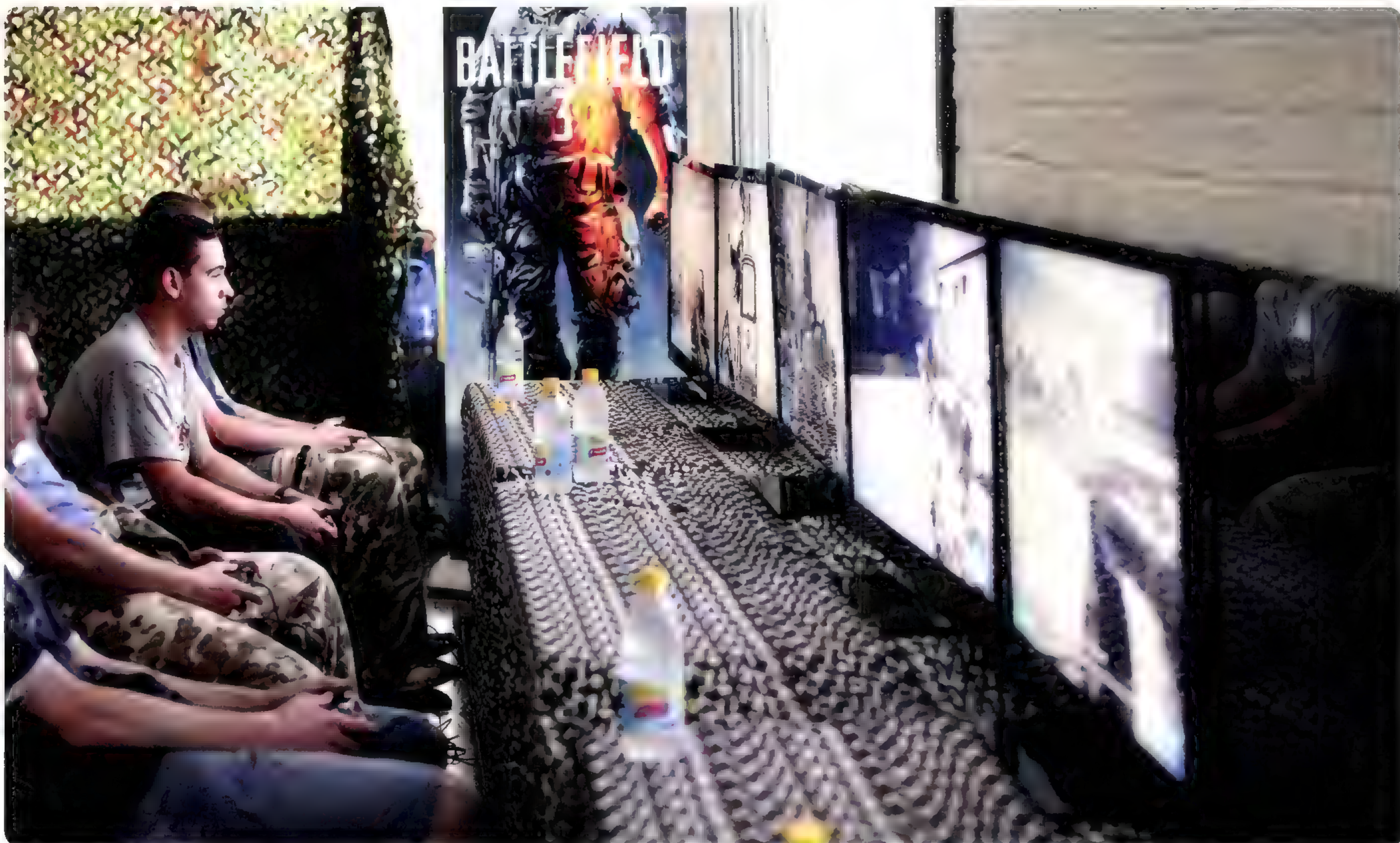
There were a bunch of Xbox 360 consoles set up to showcase the new Arkham City game, alongside an exclusive preview of Lord of the Rings: War in the North.

And to round it all off, Thermaltake brought their cases with PC guts inside, with both RAGE and Skyrim giving Atomicans plenty to keep themselves occupied – Thermaltake even had a pro StarCraft 2 player to challenge those plucky enough to put themselves on the line (as shown in a forum member's video).

Intel were also present, and they gave away tickets to the VIP Atomic and Intel event. Very exclusive!

We'd like to extend a big thanks to all our vendors for sponsoring the event, not least Monash Uni for the space, and to the Atomicans who came along and made the day great. See more online at: www.atomicmpc.com.au/?280398 JR





Atomic's Battlefield 3 Paintball Night

You're not a man until you've been paintballing. Even if you're a woman. Or something.

To celebrate the launch of Battlefield 3, we went through about 11,000 paintball pellets Thursday 20th of October, which is a fun time by anyone's reckoning.

However, the paintball was the sideline event – the main attraction at our latest Atomic gaming night was letting 32 lucky readers get to grips with the singleplayer campaign in the

upcoming Battlefield game, and if the night was anything to go by, the game's going to be big. The opening levels showed off a perfect mix of BF3 gameplay, from infantry action to jet missions and tank battles, and despite the awkwardness of dedicated PC gamers flailing about with controllers, pretty much everyone walked away impressed.





The event was held out at our new favourite paintball venue, Sydney Indoor Paintball at Peakhurst. It's a single indoor field, screened by mesh netting, so onlookers are (mostly) safe. Above the action is a great little ready room where we had three PS3s, three Xboxes, and the bar setup. While early arrivals got to play a bit of the game (levels two, three and four, to be

up getting the fastest victory – and it must have been fast, because the team I subbed into managed to clean up the opposition for zero losses in one minute, 34 seconds in one of our rounds.

Go Team Delta!

However, the win – and eight Battlefield 3 messenger bags – went to Team Alpha. Well done guys – that's some great paintball!

EA had more up its sleeve, though, and gave away a Razer Onza Xbox




To say the action was epic... The smaller relative size of the indoor field meant from the first whistle, it was on.

precise – level one was hidden to stop rumours leaking ahead of launch), the real 'multiplayer' action started once everyone got there. We split into four teams of eight players each.

To say the action was epic is an understatement. The smaller relative size of the indoor field meant from the first whistle, it was on. Paint flew thick and fast, and during the course of 12 rounds of action one team ended

controller, five lots of five Laser Skirmish passes, a signed BF3 poster, and copies of the game. It was a prize fest!

So thanks to both EA and Sydney Indoor Paintball, and especially you Atomicans for another great gaming night! Keep your eyes peeled for our next event; it's likely just around the corner.  DH



LIVE or let die

Like most right-thinking people, Ben Mansill loves Steam and Xbox LIVE, but wonders why Games for Windows Live is so appalling.

Remember when everyone hated Steam? It was the big rage-storm of 2002, when the Steam client was first released to support patching Counter-Strike 1.6 beta. Using Steam was mandatory, and the 300,000 or so beta participants weighed the Steam servers down to the point of inoperability. That a typical Counter-Strike player will rage hard at the slightest problem didn't help when the horde faced a legitimate obstacle to their playing of the newest, most exciting version of their game. Cue en-masse nerdrage.

We could vaguely see the potential, but that wasn't the point. After all, a patch could simply be downloaded from any number of fast hosting sites. This appeared to be innovation for innovation's sake. A heavy-handed gambit from a game developer which at the time, had just about the strongest goodwill from any community. Steam was an obstacle to playing, the experience was miserable, and it remained horrid for not days or weeks, but *months*. If it wasn't connection errors, it was treacle-slow downloads, and given the frequency of CS: 1.6 updates it was an experience you were forced to endure with painful regularity.

Why was a relatively small developer doing this? Surely this closed patch system had FAIL written all over it, and Valve would inevitably

GFWL has the resources of Microsoft behind it. Yet it's an abhorrent disgrace.

abandon the experiment. Half-Life 2 was a couple of years away. Please, Valve, don't wreck it with Steam, many thought.

Well looky now. Who doesn't love Steam? Anybody? An estimated 70 per cent of all digitally distributed games are sold through Steam. It has over 35 million active users. It is the lifeblood of so many indie devs which would have struggled to earn sales without it. It has been embraced by almost all the major studios and distributors. Only pricing remains a sticky point, and a fair cop that is.

But in most regards Steam has it all. Downloads are usually rocket-fast, patching is transparent and automatic, there's cloud storage and backups, we can pre-load games so that literally the minute a game is officially released we can play it.

It's cool, it's got cred. Quality support from Valve with updates and new features is just beautiful. Heck, it even looks sexy. The look and feel of the interface is sublime; it draws you in and encourages exploration. Loading Steam up on a new day usually delivers pleasant surprises. And it hasn't detracted one bit from the



renegade cool-factor that Valve thrives on. It has, in fact, significantly enhanced Valve's reputation.

Then there's Games for Windows Live.

It's been with us since 2007, so while Valve got a head start with Steam, GFWL has the resources and talent of Microsoft behind it. Yet it remains an abhorrent disgrace.

It was hailed as a PC version of the Xbox LIVE experience. It arrived as... well, words can't describe the differences between LIVE and GFWL. LIVE is a slick, rich, complete service. GFWL is a basic shell of the barest minimum features, all done badly.

It fails at community; being the top thing it was marketed for, where LIVE and Steam are state of the art. It can't be run from the desktop as a standalone application, there's no easily-accessible offline mode and it has no chat facility. No chat! Voice has no push to talk, or mute player, and some publishers have explicitly warned against using it due to the bandwidth it consumes, affecting gameplay and even causing dropouts. So much for community.

The list of what GFWL does badly is about as long as the list of what it doesn't do at all, and alas, a mere page here in Atomic isn't enough to accommodate even a sketch outline of what a mess it is.

But what we *have* all experienced is its obtrusive meddling, rearing its ugly head where it's neither wanted, nor needed. GFWL pops up during installation, it pops up when saving

games, it demands duplicate keystrokes and clicks that the game itself already has. It is entirely unnecessary at best, and a royal pain in the arse the rest of the time.

Microsoft has had five years to turn GFWL into anything other than crud, yet crud it remains. The only new feature of note is GFWL Marketplace, which is crud. There's a handful of games to buy, and they're all framed all in the same sterile, un-fun, corporatey look of the main GFWL UI. Yuck.

GFWL exists purely as a DRM mechanism. Pretending that it offers anything of genuine use or benefit to PC gamers is a lie. It is a hindrance, an annoyance, and as strong a statement as you could ask for that PC gaming is regarded by Microsoft with cold indifference.

Developers who chose the GFWL platform are automatically cast into the "we don't care about you, either" basket. GFWL is structured to provide all its benefits to developers, not to the gamers who buy the product.

GFWL has been left stagnant since launch. For the revenues it brings Microsoft it probably represents the greatest return on investment in Microsoft's catalogue, and thus, it won't be killed off for as long as it can be tacked onto new games.

I wonder: if it were an optional service, just how many gamers would *choose* to use GFWL? Tens of millions of gamers unhesitatingly *pay* to use Xbox LIVE – Microsoft knows how to do it right, they just won't.

Windows 8 is said to support full LIVE integration. So is GFWL a dead-end street? Will MS let it fester until Win 8? Can they ever be trusted by PC gamers again?

We simply don't know.





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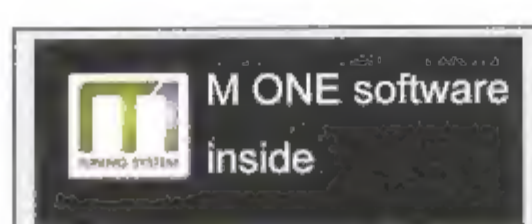
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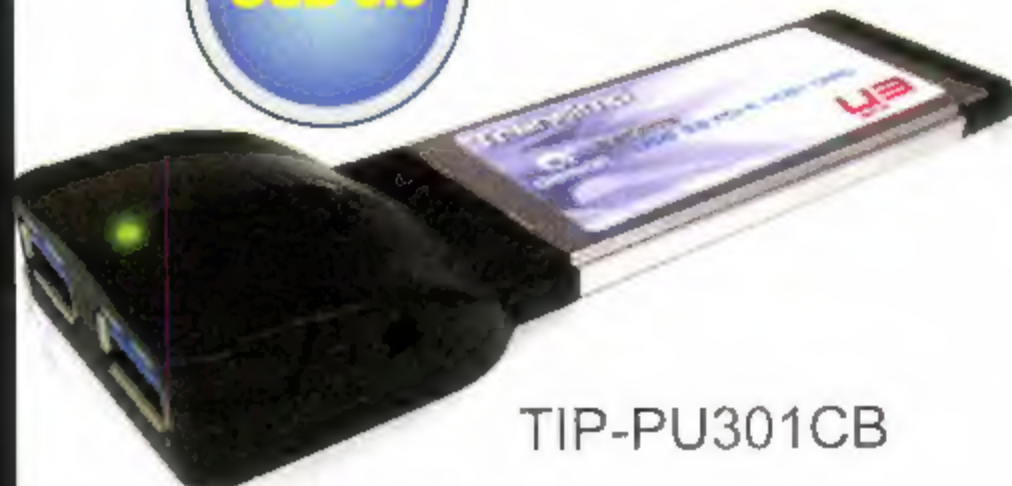
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